

# THE REALITIES OF NEW ENGLAND HURRICANES

**BOB, 1991**

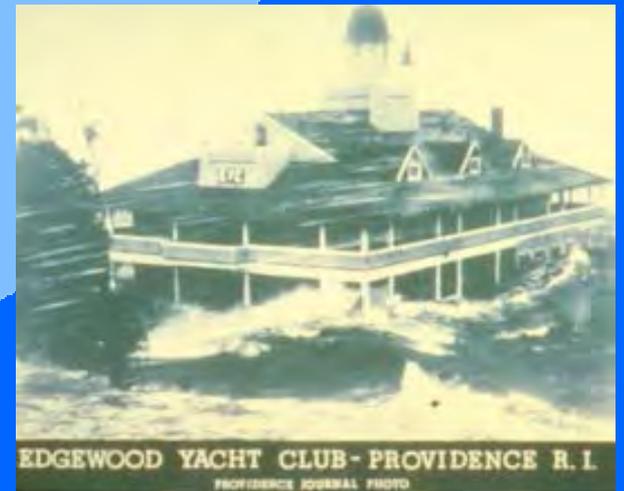


**NOAA**

**CAROL, 1954**



**1938 HURRICANE**



People of my generation remember Bob (1991),  
Gloria (1985) – we have a *Warped Sense of Reality*

**People Confuse Memory  
and History**

**We Act not on History, but on  
Our Perception of History**



# TROPICAL STORM IRENE



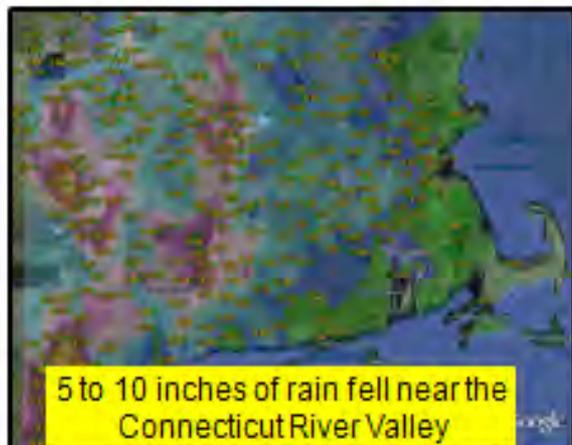


# Southern New England Impacts from Irene

Joe Dellicarpini and Rebecca Gould  
NOAA/National Weather Service  
Taunton, MA



## MAJOR RIVER FLOODING

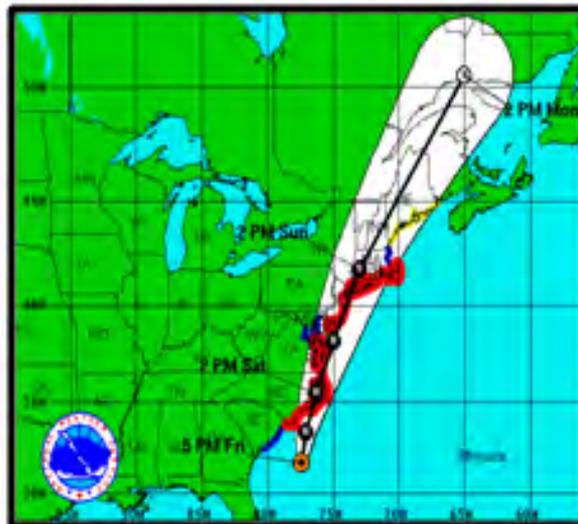


5 to 10 inches of rain fell near the Connecticut River Valley



Connecticut and Deerfield Rivers

## The Importance of Storm Track



As Irene tracked through western New England, the heaviest rainfall fell along and west of the center. The strongest winds and coastal flooding occurred to the east. This is typical of tropical systems that impact New England.

## DAMAGING WIND GUSTS



Gusts reached 60 to 80 mph in Rhode Island and Massachusetts.



# COMPARISON OF TROPICAL STORM IRENE VS. A MAJOR HURRICANE

## TROPICAL STORM IRENE

Wind Gusts from Irene reached a maximum of 67 MPH.

T.S. Irene downed approximately 1 – 2% of the State's Trees

T.S. Irene resulted in over 800,000 power outages requiring 9 days to fully restore.

Total damages estimated at 200 Million Dollars

Governors S.T.O.R.M. Briefing

## MAJOR HURRICANE

Instantaneous Maximum Wind Gusts in a fast moving major hurricane can reach close to 200 MPH.

A major hurricane may down up to 70 - 80% of the State's trees.

A major hurricane may black out the entire state, some areas for an extended period of time (over a month).

Total damages estimated in the tens of billions of dollars.

October 25<sup>th</sup>, 2011



# Estimated Damages to Connecticut (HAZUS MH)

**Direct Economic Losses to  
Buildings which are the Combined  
total of Building Damage and  
Economic Disruption**

**54.2 Billion Dollars**



# Estimated Sheltering of Storm Victims

(HAZUS MH)

## 144,131 Displaced Households

## 364,651 Displaced Individuals



# ESTIMATED CRITICAL FACILITIES FUNCTIONALITY

(Police, Fire, EMS)

## THE DAY AFTER A MAJOR HURRICANE

3%



# ESTIMATED HOSPITAL FUNCTIONALITY AFTER A MAJOR HURRICANE

DAY 1 - 3%

DAY 3 - 12%

DAY 7 - 15%

DAY 30 - 40%



**ESTIMATED DEBRIS CLEANUP  
AFTER A MAJOR HURRICANE  
47 MILLION TONS  
EQUALING 1,900,000 TRUCK  
LOADS  
(Equal to all the trash Generated in  
Connecticut in 1 Year)**



- Four Category 2 & 3 hurricanes in a 16-year period:

Great New England Hurricane of 1938 (3)

Great Atlantic Hurricane of 1944 (3)

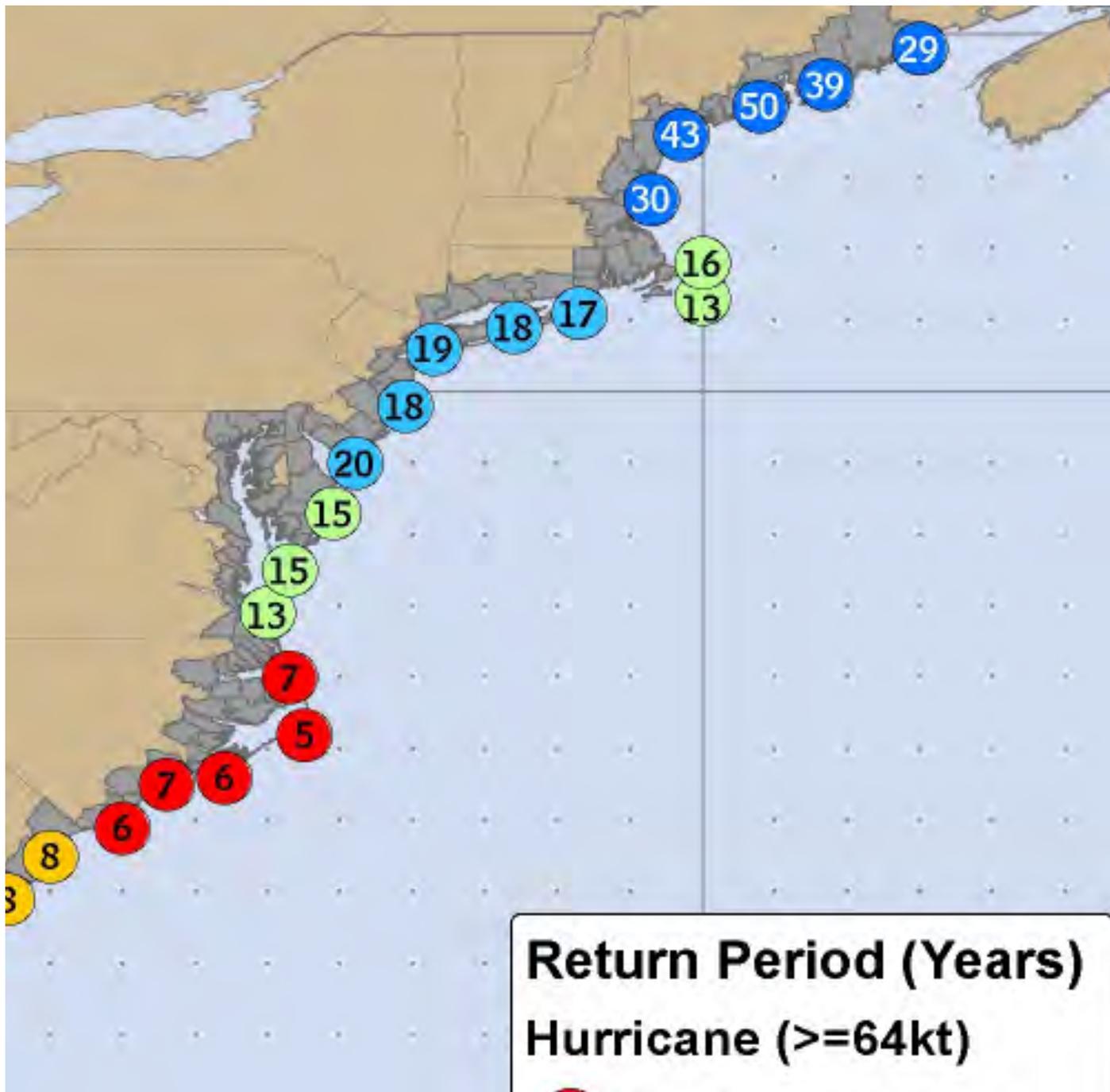
Hurricane Carol – 1954 (3)

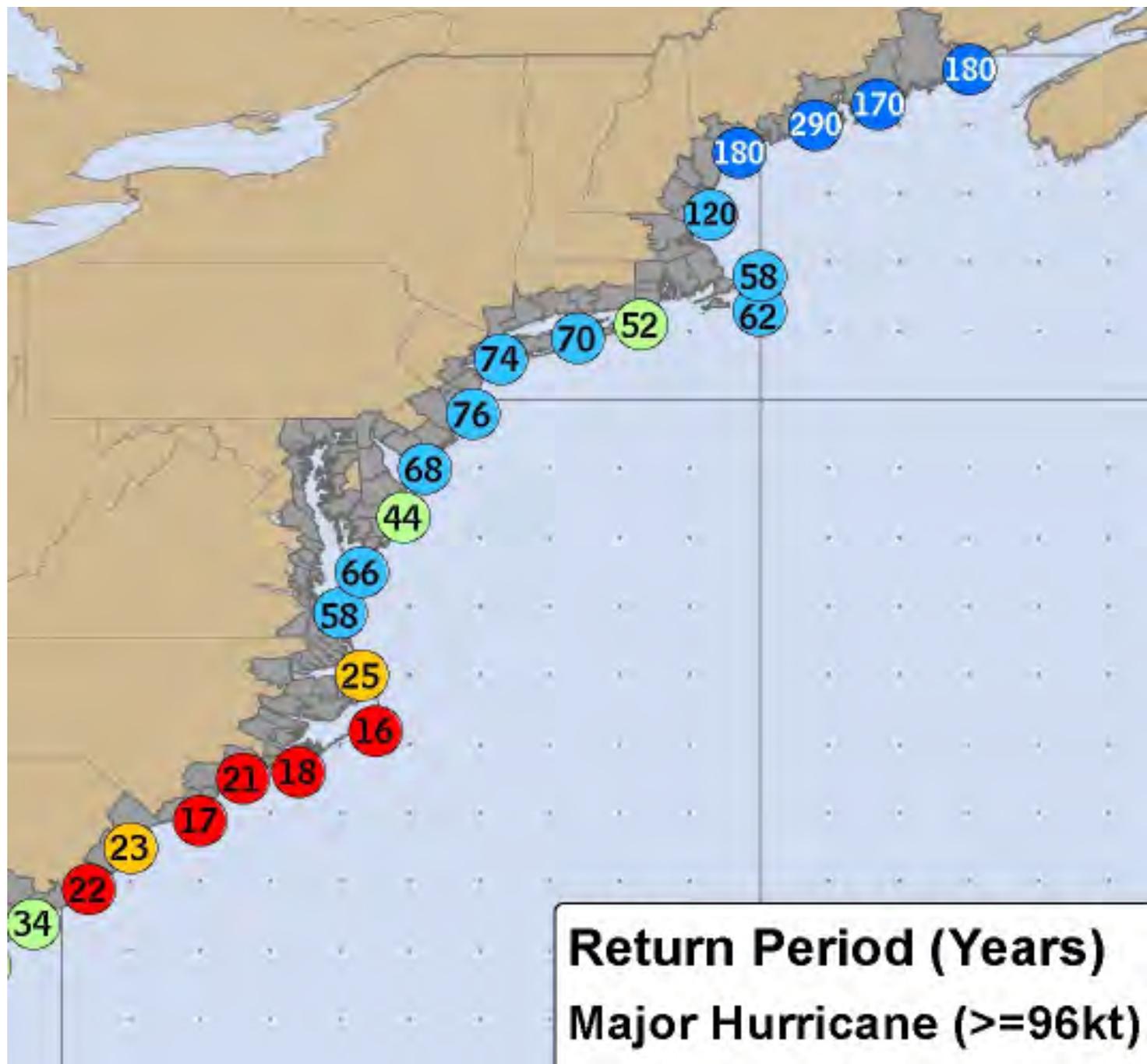
Hurricane Edna – 1954 (2)

(occurred within 12 days of each other!)

**And none in past 61 years !**

**Low Frequency, High Impact !**



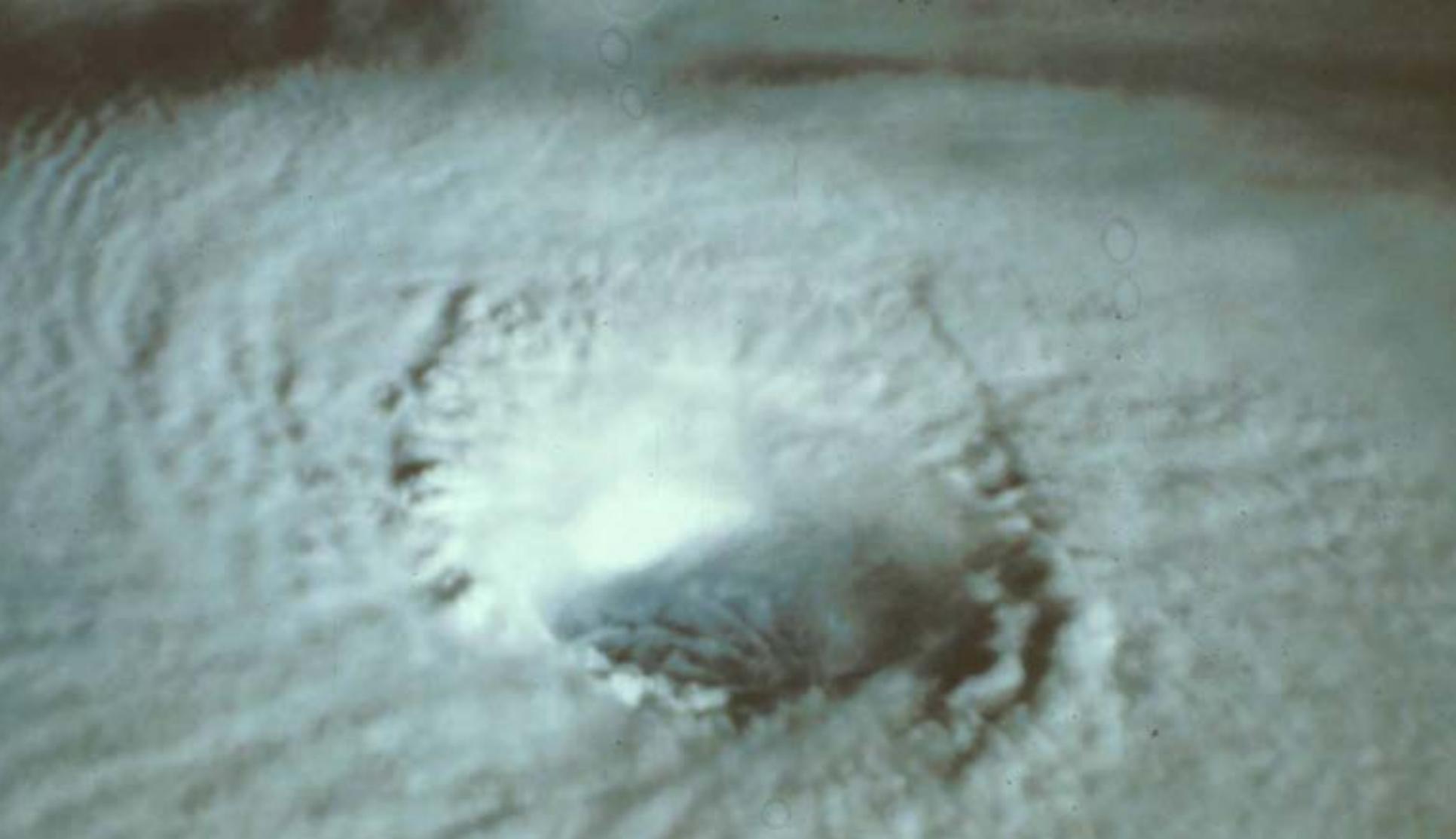




# THE HURRICANE

View of Hurricane Elena from  
Space Shuttle (1985)





THE EYE OF ELENA,  
(AS SEEN BY THE SPACE SHUTTLE)



**No hurricane talk would be complete without first thanking the Air Force for their reconnaissance missions, which provide us with critical information!**



# SOURCE REGIONS: Cape Verde & Bahamas



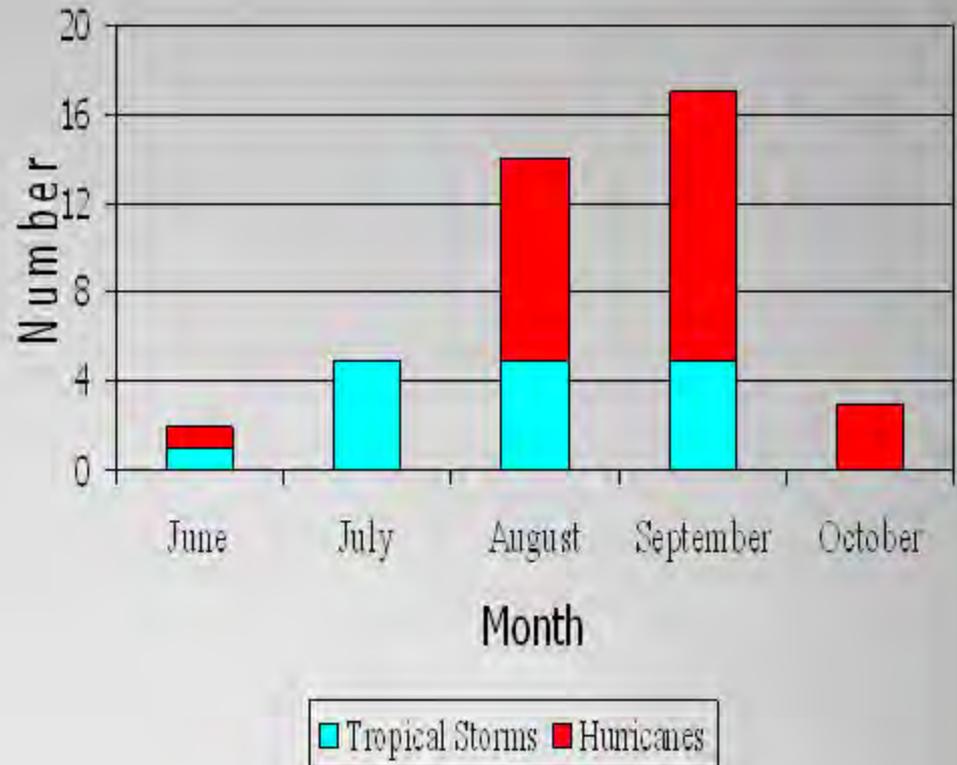
- Our most active months!

Warmest ocean temperatures

Start of transition to Autumn

- Strong jet streams could dig deep into the South and can capture tropical systems in the Bahamas

Monthly Tropical Cyclone Distribution

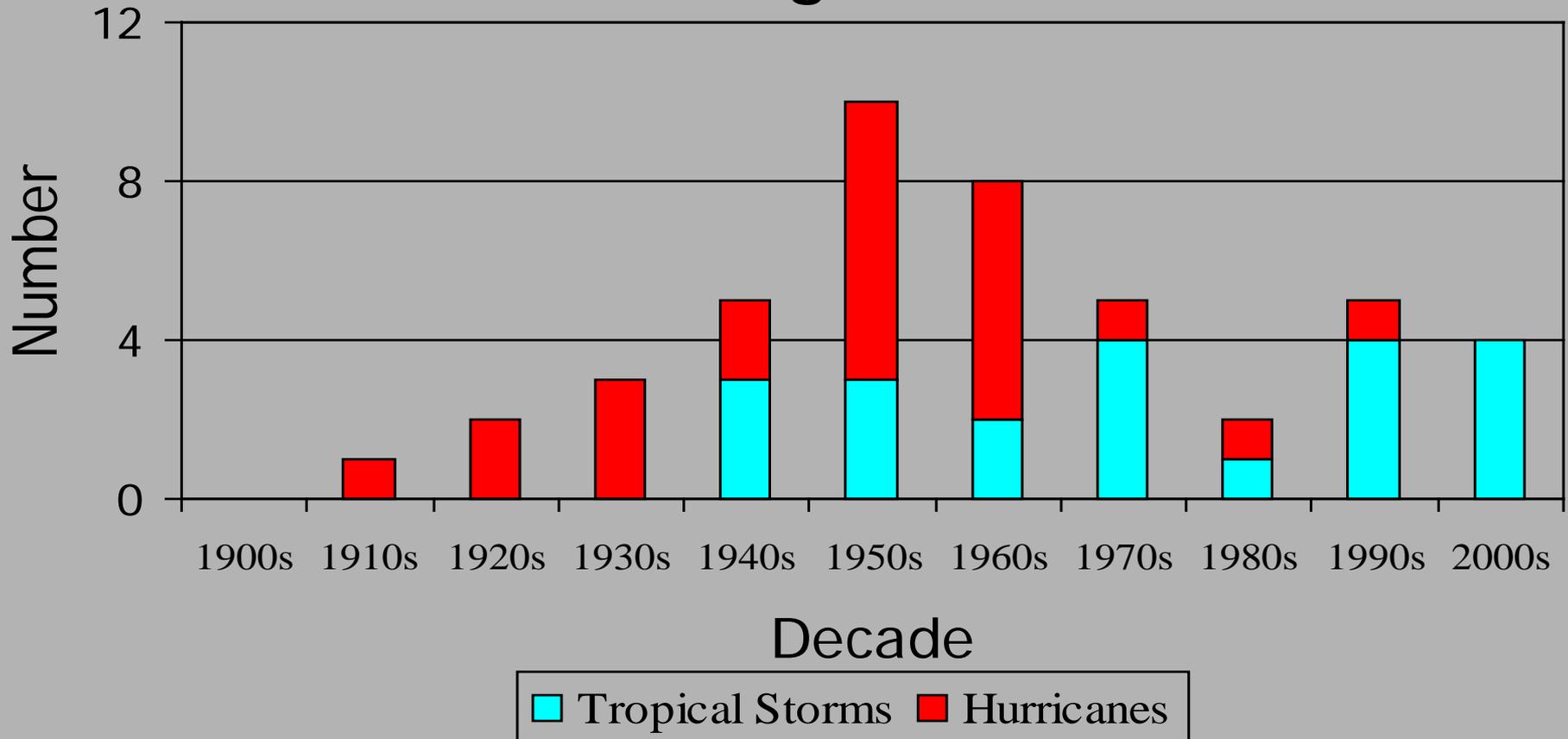


**August and September**

# Active vs. Inactive Periods

*1930s-1950s active vs. 1970s-1980s inactive*

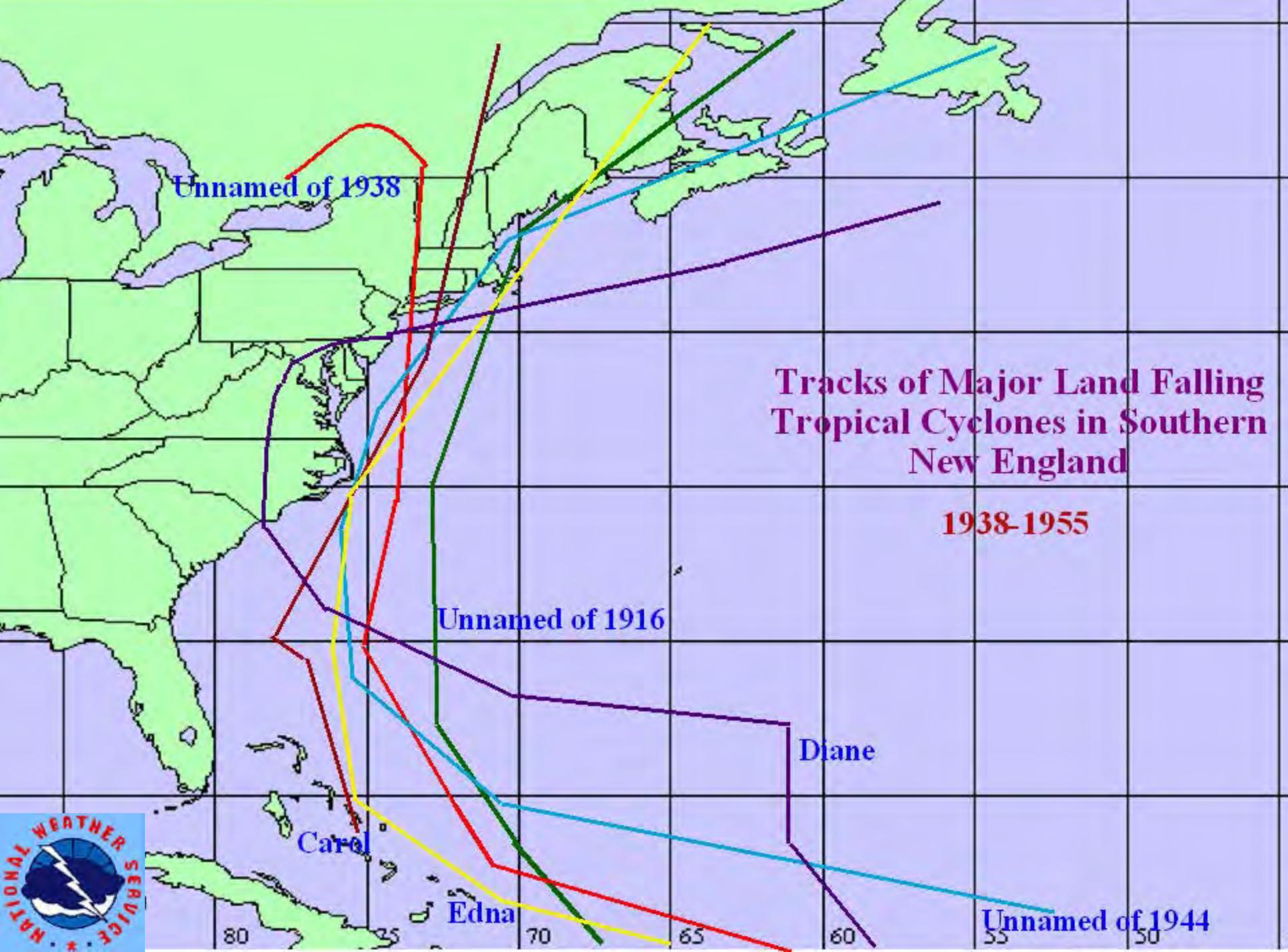
## Seasonal Tropical Cyclone Frequency Southern New England 1900-2005



# TROUGH IN THE EAST

This pattern can “capture” the tropical system!





Unnamed of 1938

# Tracks of Major Land Falling Tropical Cyclones in Southern New England

1938-1955

Unnamed of 1916

Diane

Carol

Edna

Unnamed of 1944



80

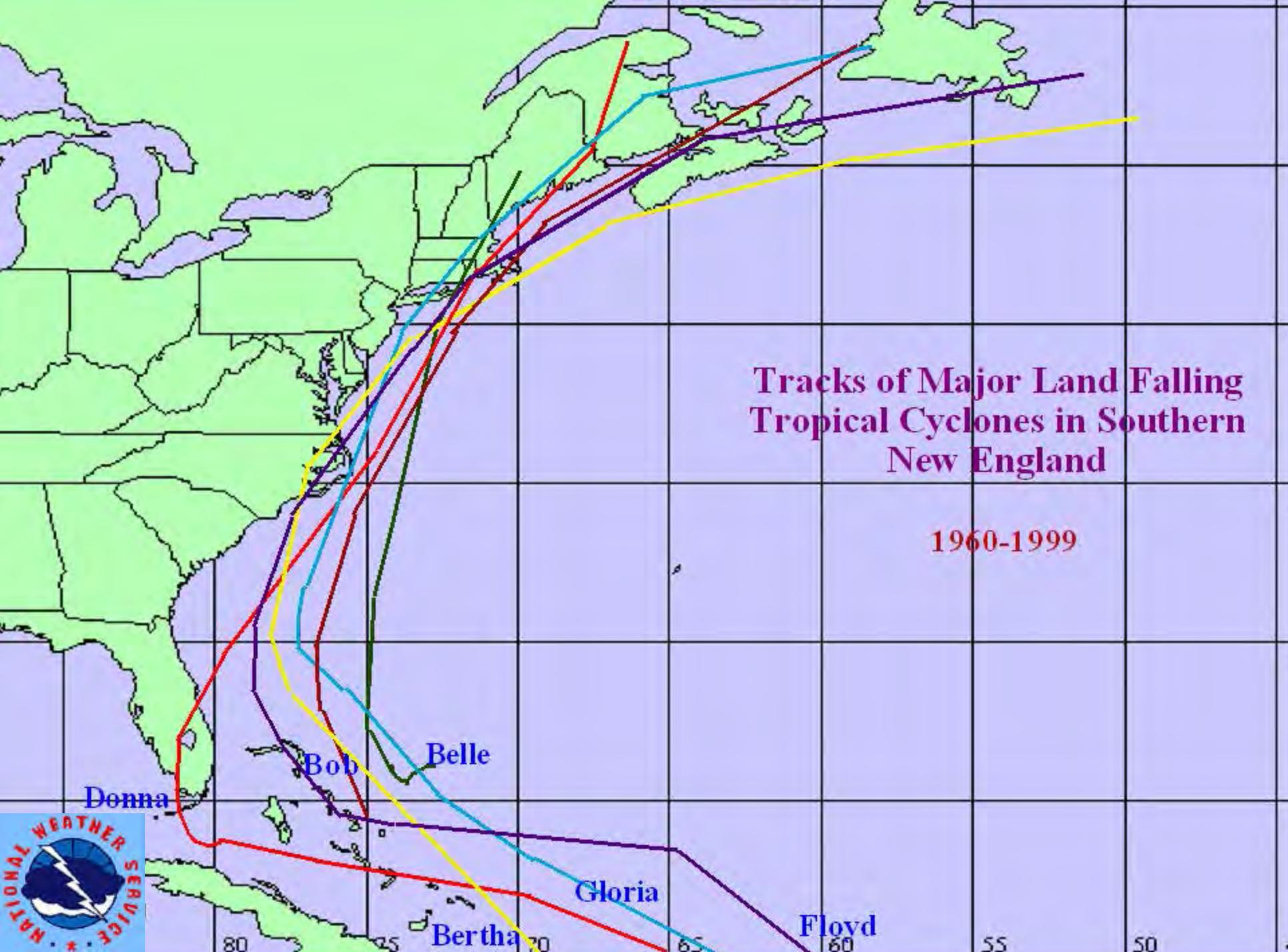
70

65

60

55

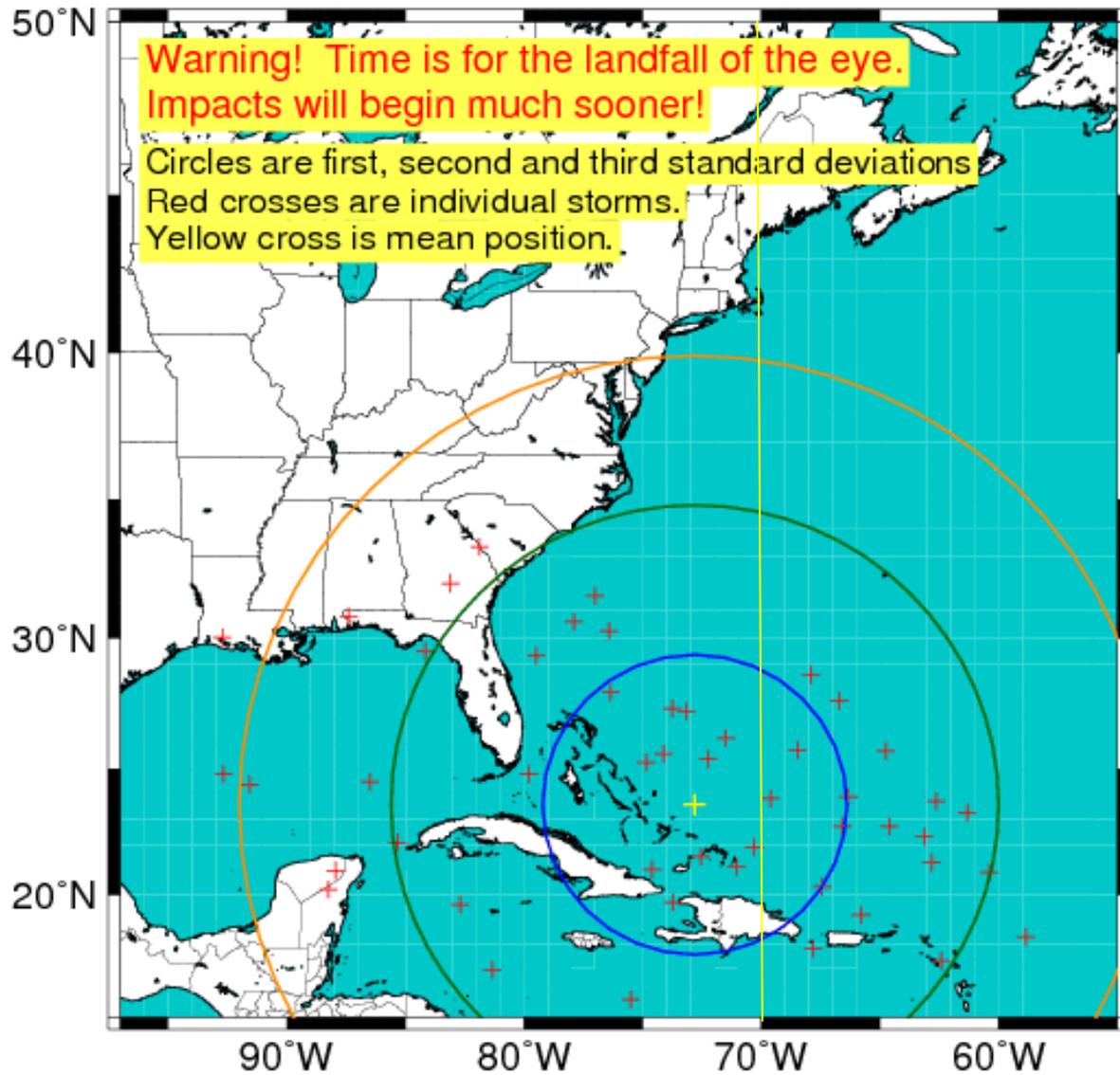
50



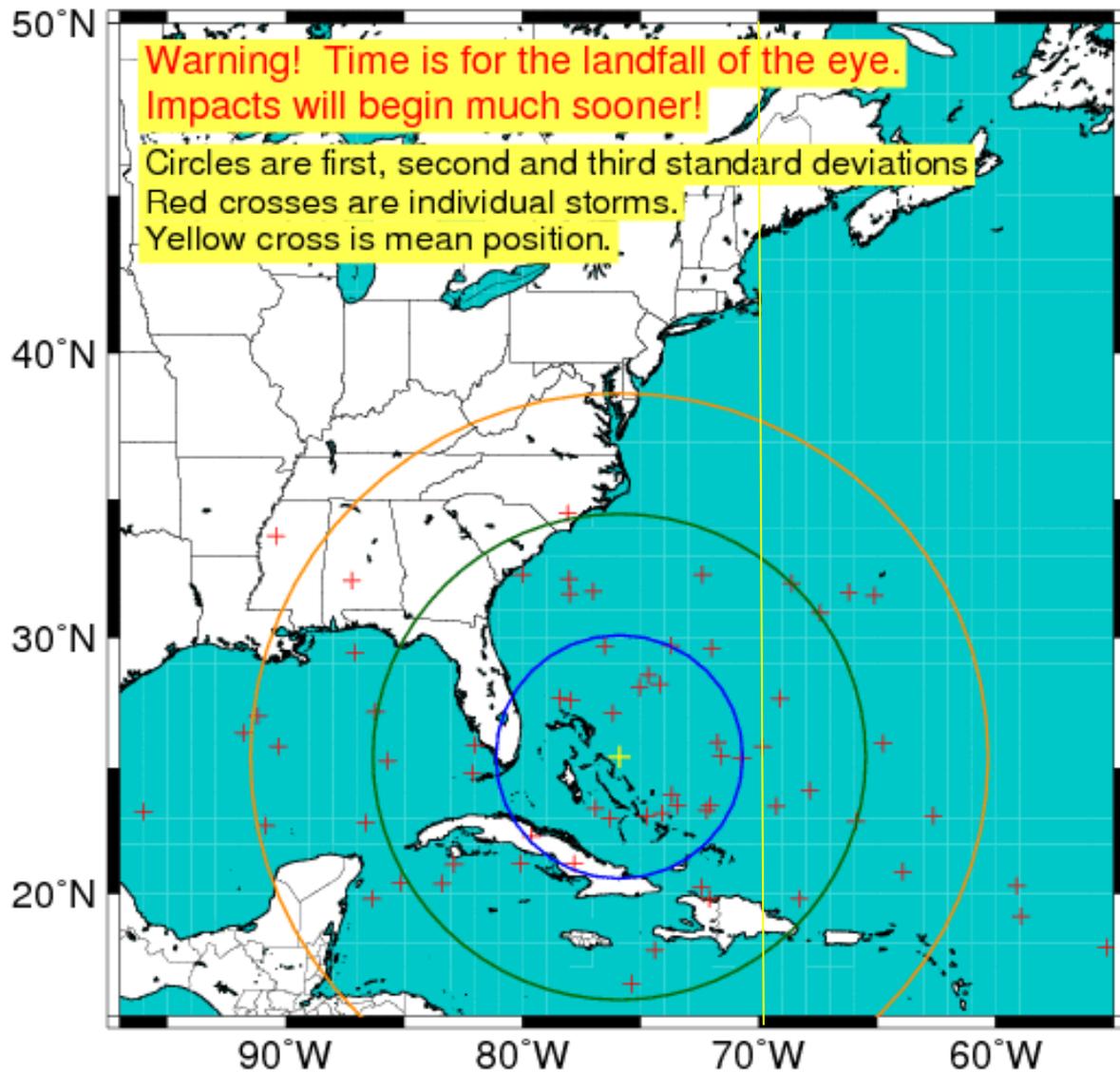
# Common Characteristics

- **Rapid acceleration up the coast**
  - Average speed – 33 mph as they raced through
- **Heavy rainfall usually focused along and west of the storm track**
  - Nearly  $\frac{1}{2}$  of the storms since 1900 produced river/small stream flooding!
  - 6-8 inches of rainfall
- **High winds focused east of the track**
- **Storm surges focused east of the track**

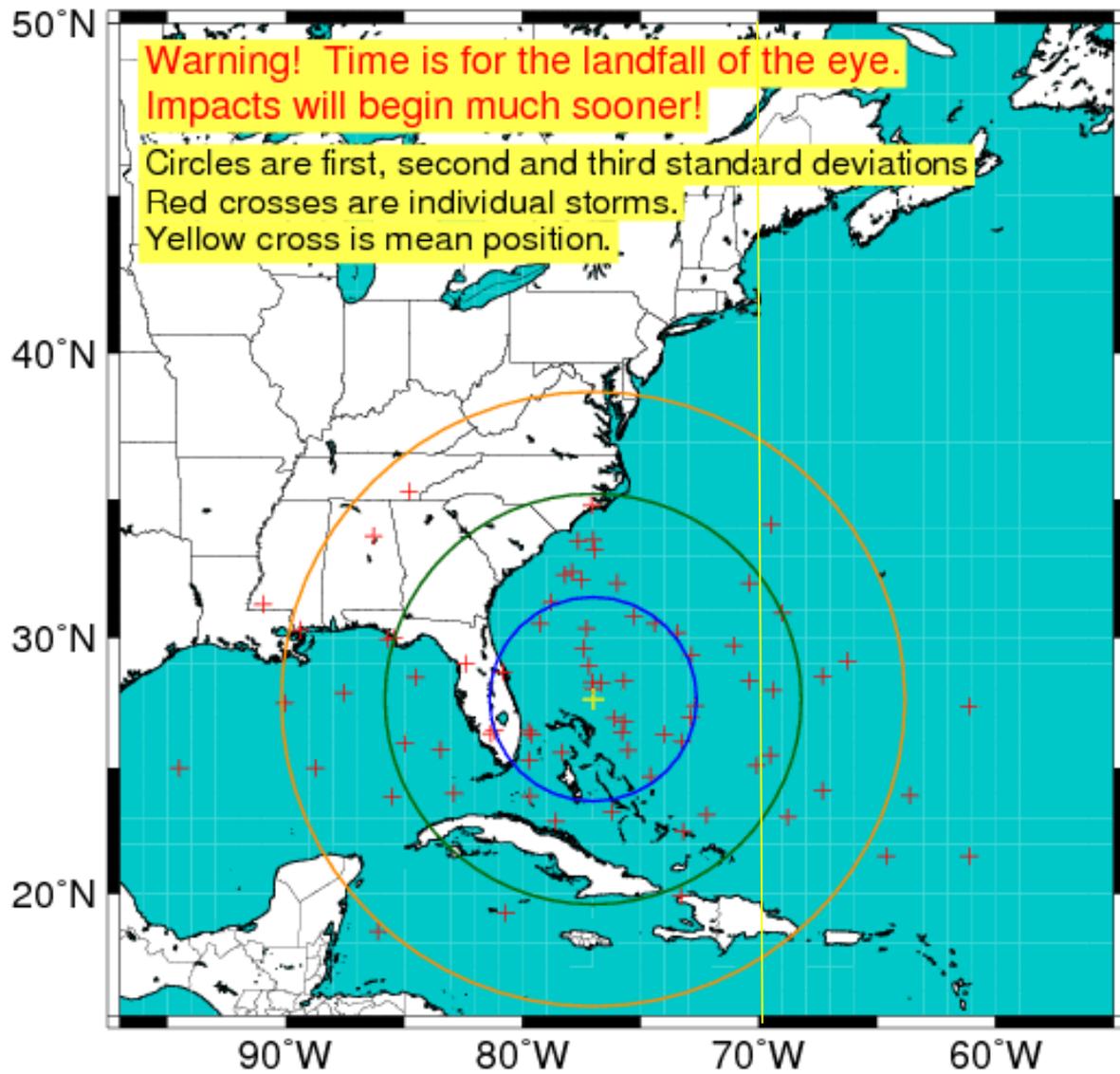
# Position of All Storms At 120 Hours Before Landfall of Eye



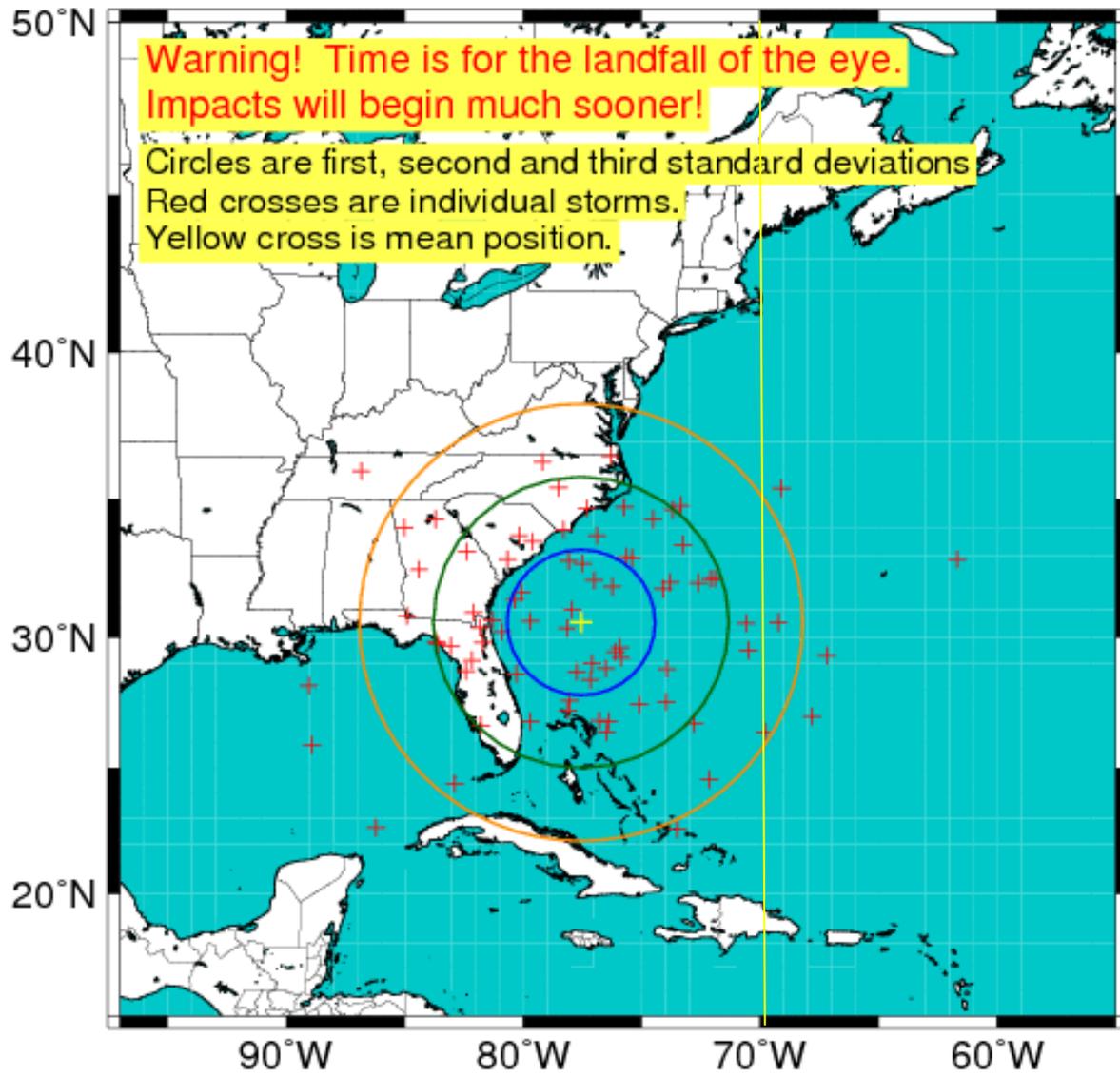
# Position of All Storms At 96 Hours Before Landfall of Eye



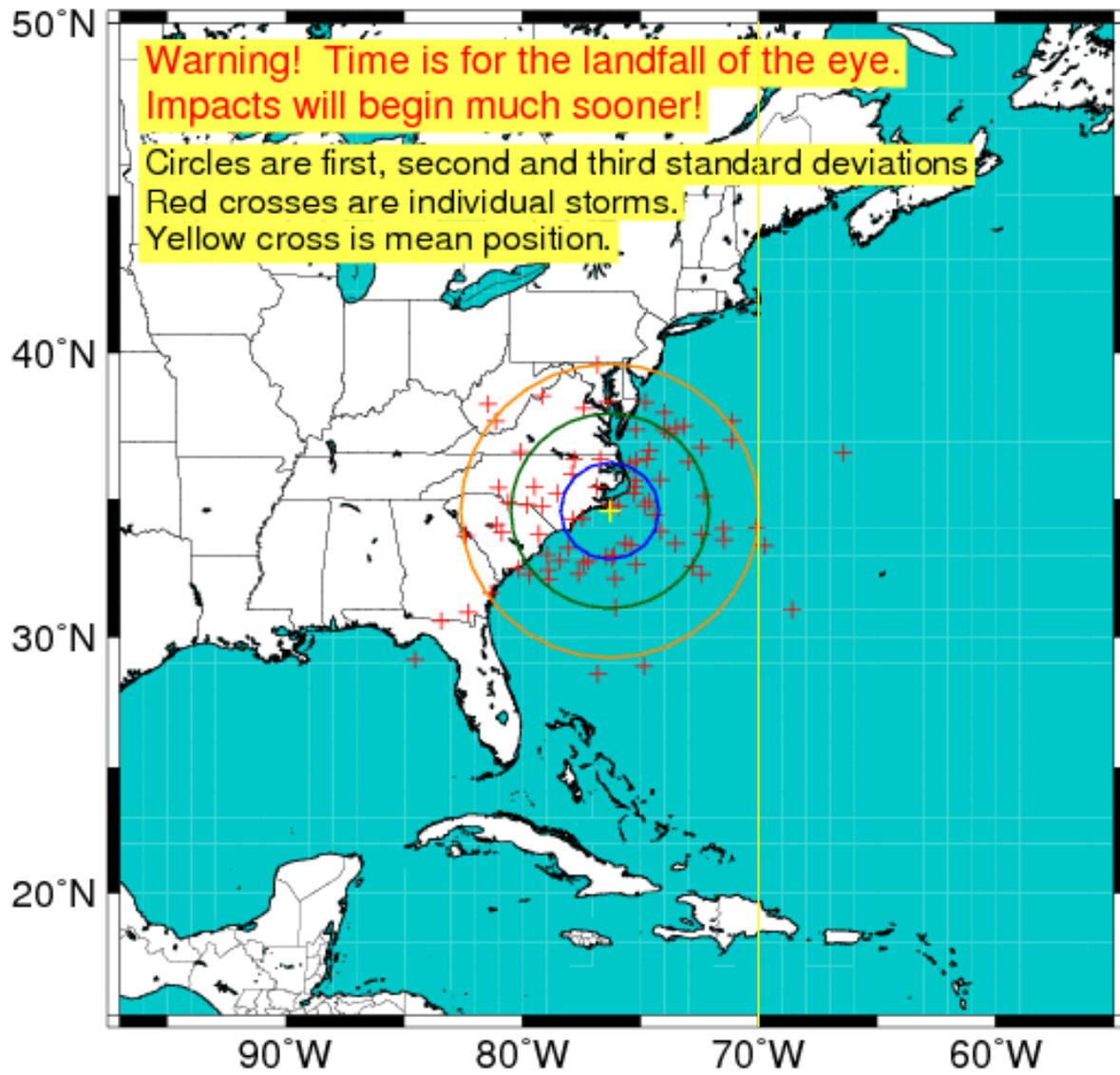
# Position of All Storms At 72 Hours Before Landfall of Eye



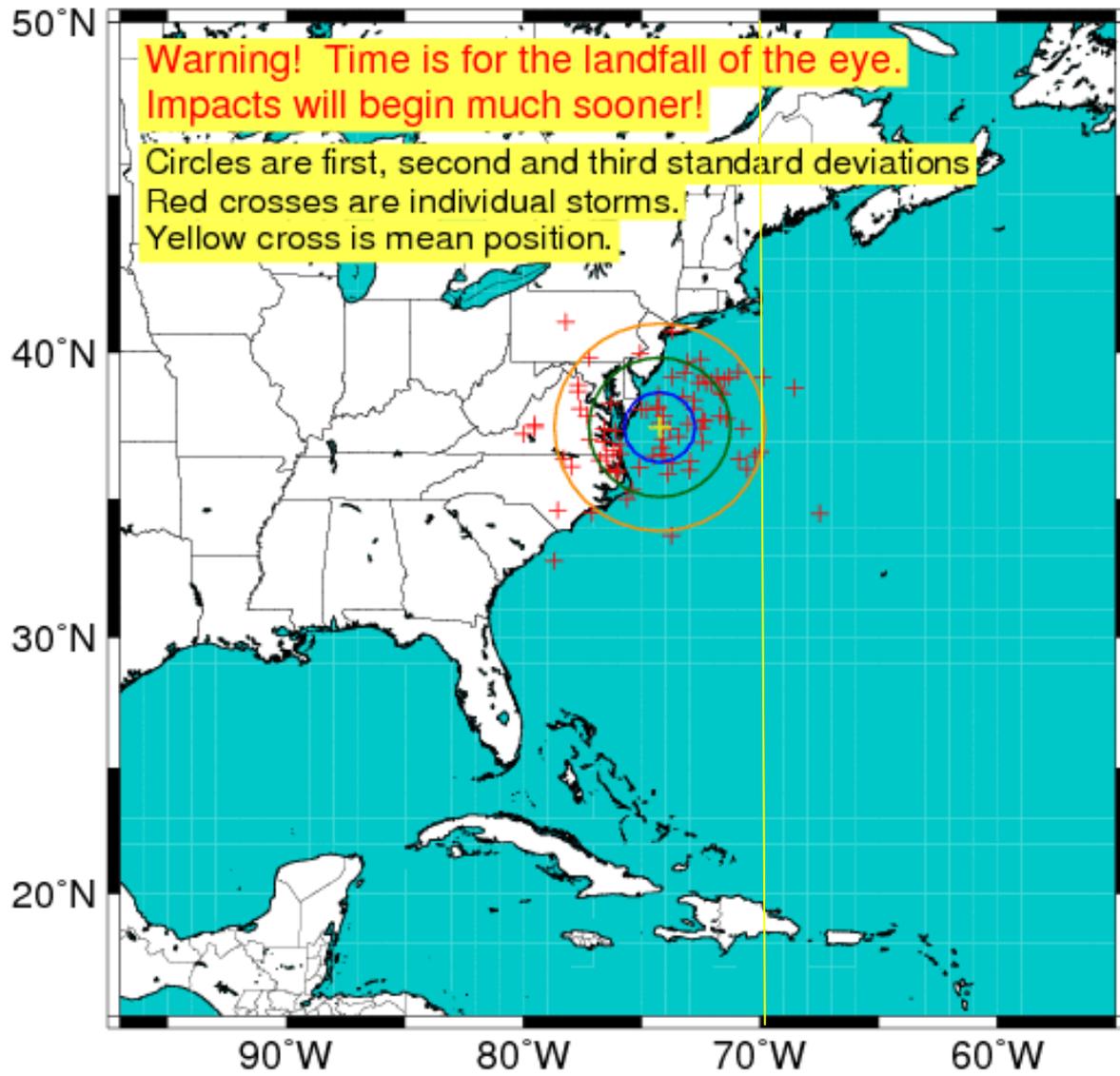
# Position of All Storms At 48 Hours Before Landfall of Eye



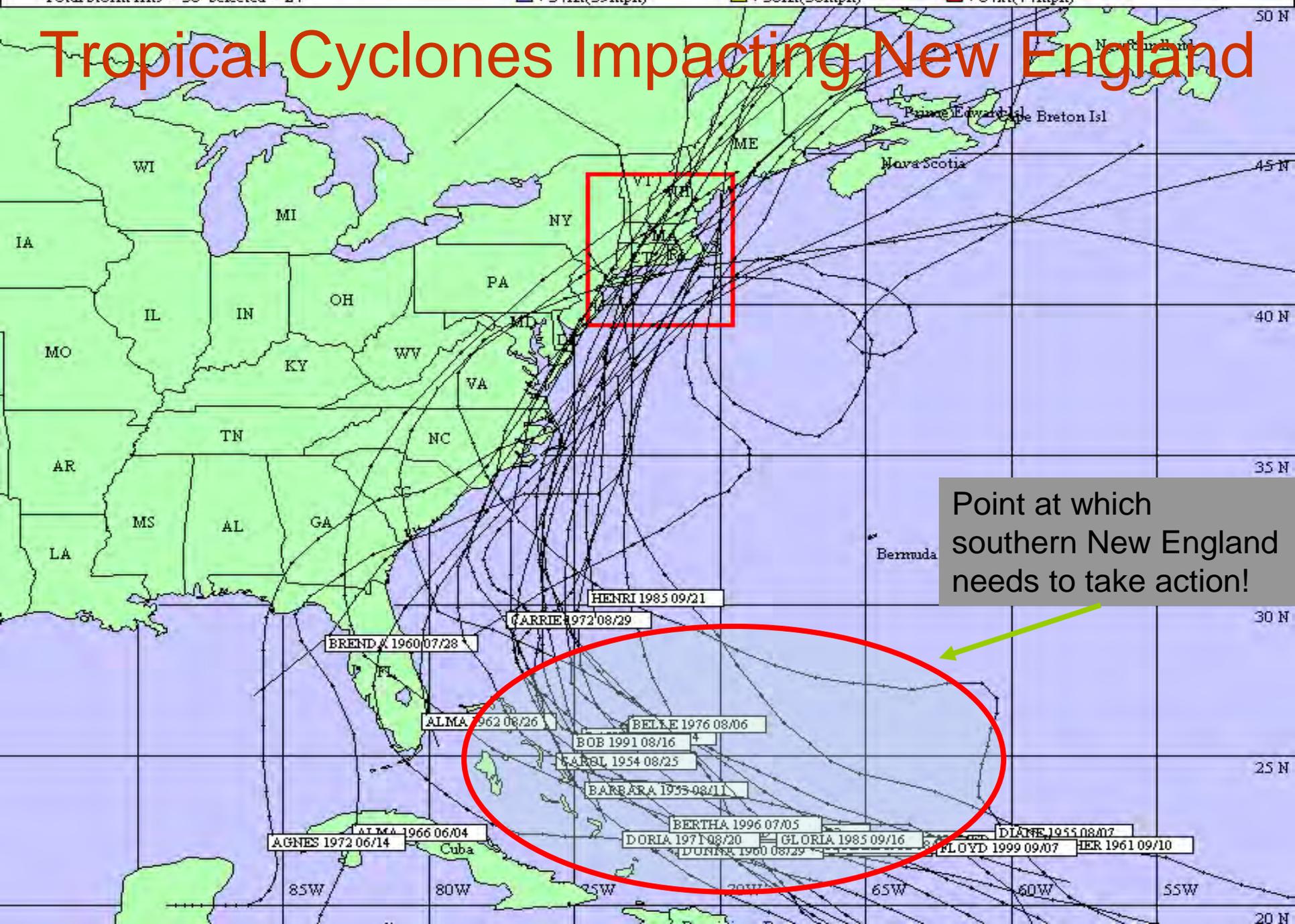
# Position of All Storms At 24 Hours Before Landfall of Eye



# Position of All Storms At 12 Hours Before Landfall of Eye



# Tropical Cyclones Impacting New England



- HENRI 1985 09/21
- CARRIE 1972 08/29
- BREND 1960 07/28
- ALMA 1962 08/26
- BELLE 1976 08/06
- BOB 1991 08/16
- FABEL 1954 08/25
- BARRARA 1933 08/11
- BERTHA 1996 07/05
- DIANE 1955 08/07
- AGNES 1972 06/14
- ALMA 1966 06/04
- DORIA 1971 08/20
- GLORIA 1985 09/16
- DONNA 1960 08/29
- FLOYD 1999 09/07
- HER 1961 09/10

# HURRICANE BOB (1991) OFF NORTH CAROLINA



## 3 RULES OF THUMB FOR NEW ENGLAND HURRICANES

1. FORGET ABOUT WHEN THE EYE WILL MAKE LANDFALL
  - ▶ The effects of the storm will be felt many hours in advance because of the northward acceleration
2. YOU MUST KNOW WHERE YOU ARE WITH RESPECT TO THE TRACK OF THE EYE, HOWEVER.
  - ▶ North & West of the track: FLOODING RAINS
  - ▶ South & East of the track: STRONGEST WINDS AND STORM SURGE
3. MAXIMUM WIND GUST AT YOUR LOCATION (EAST OF TRACK) CAN BE APPROXIMATED BY:

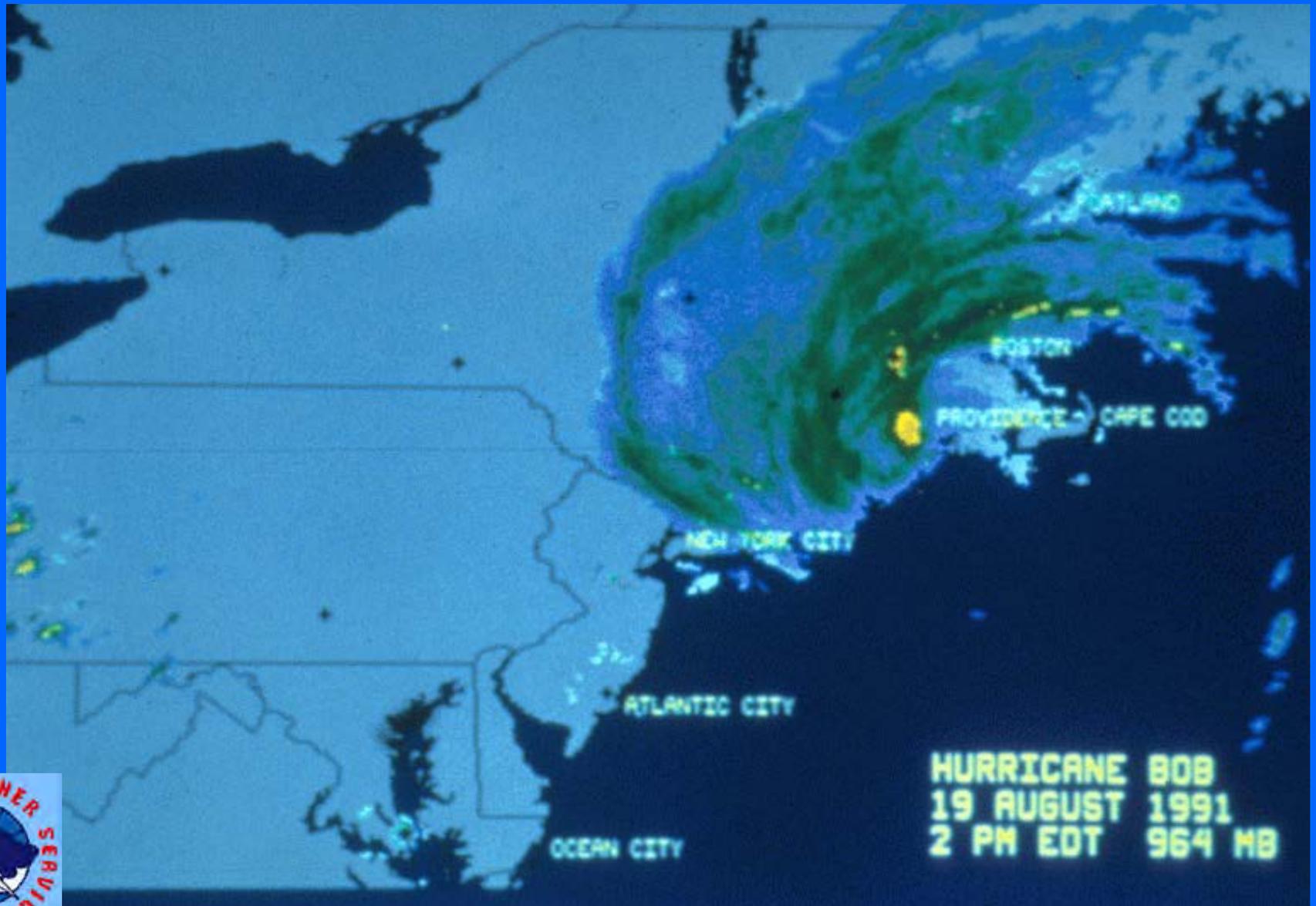
Max. Sustained Winds + Forward Motion



# 14 hours in advance of Bob, tropical storm force gusts and coastal roadways closing in Rhode Island !!



**Note the heavy rain north/west;  
sunshine and 125 mph winds south/east**



# HURRICANE HAZARDS:

WIND



STORM SURGE



RAINS

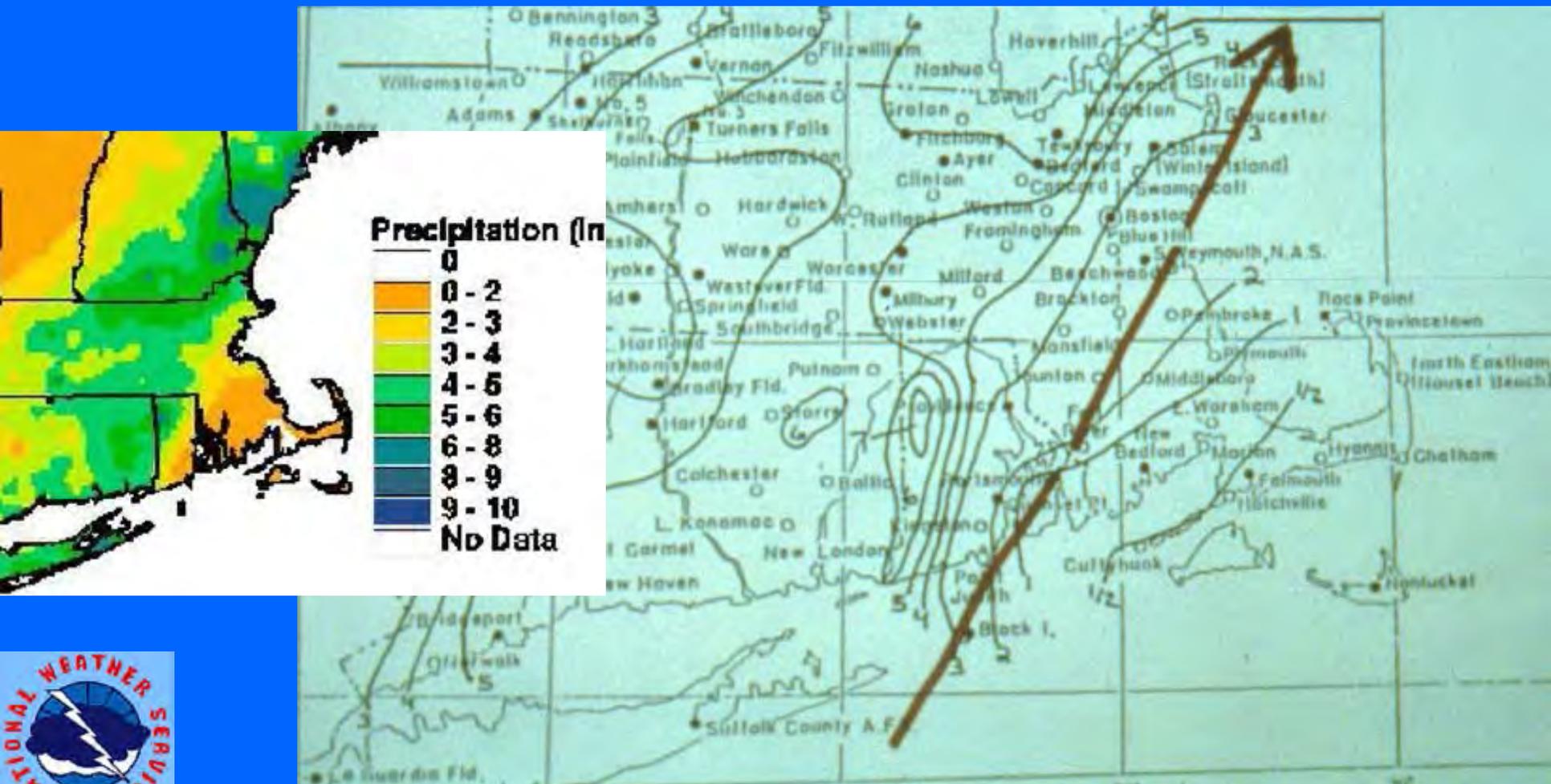


TORNADOES



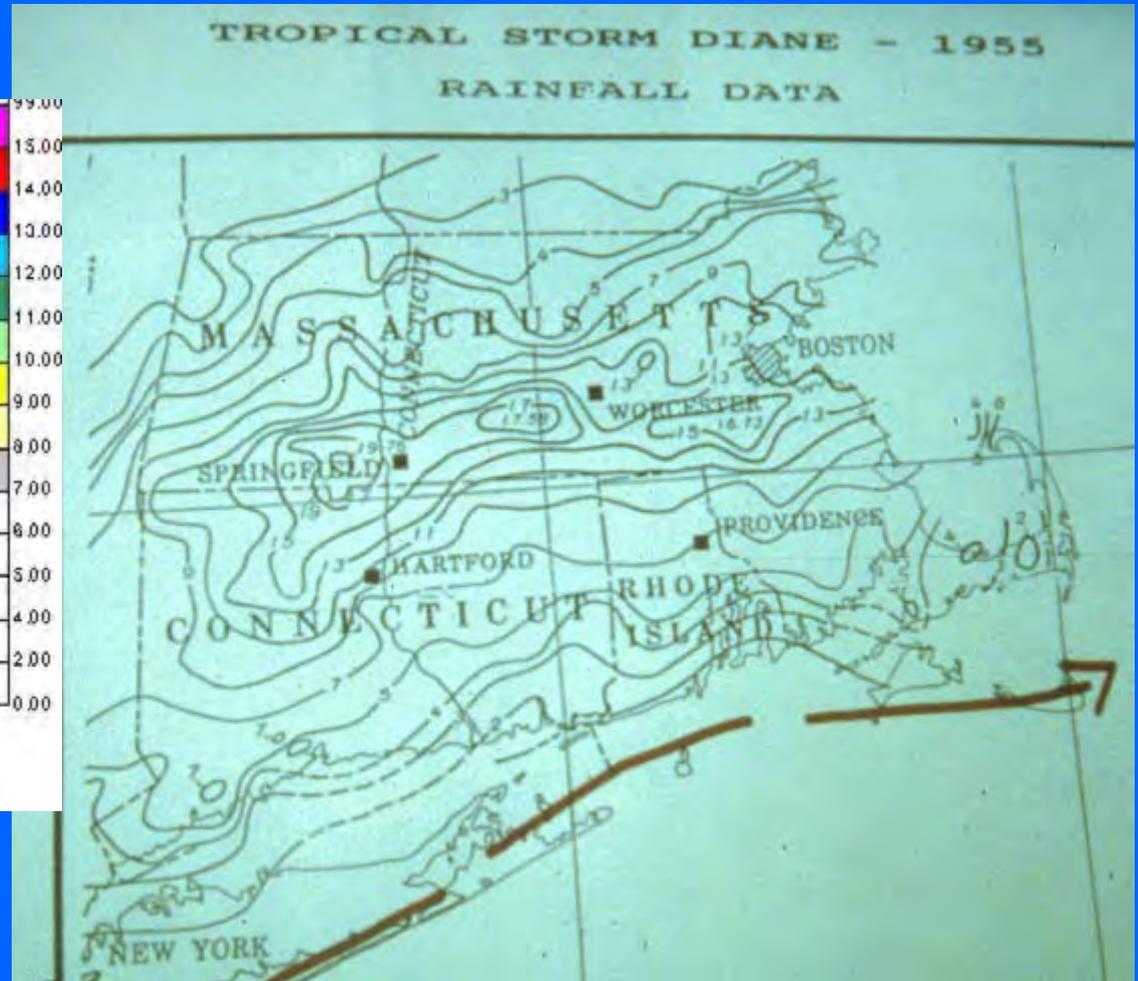
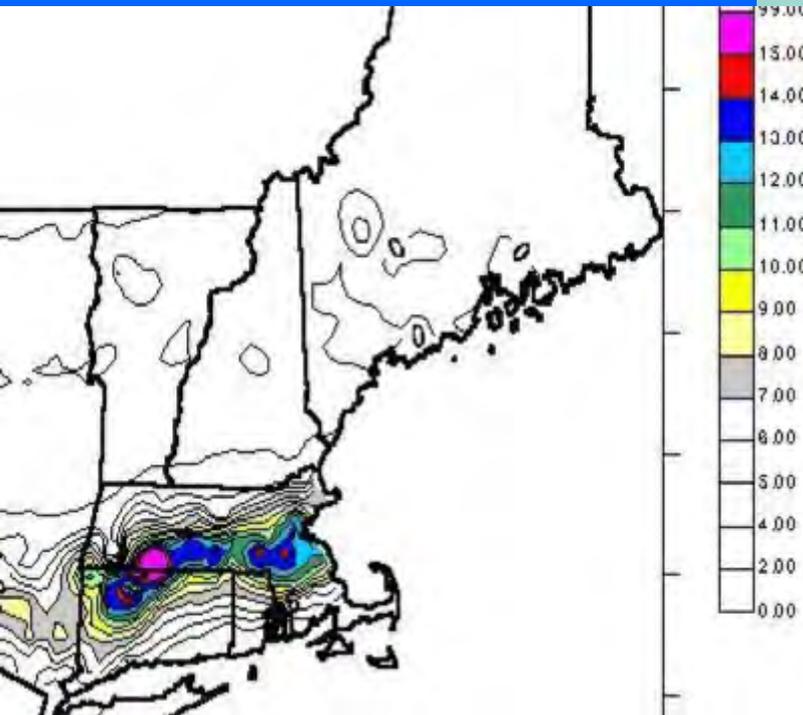
# HURRICANE BOB - RAINFALL DATA (AUGUST 19, 1991)

**½” of rain on Cape Cod; 7” of rain in Foster/Glocester, RI**



Shortly after Connie, Diane dumped 18.15" in Westfield, MA in one day – almost half their *annual* rainfall.

AUG. 17-20, 1955



Dave's grandmother used to say...

Speaking of cows...



## Inland River Flooding - Diane (1955)



Consider the region's flood history  
*It's often snowmelt or tropical rains!*

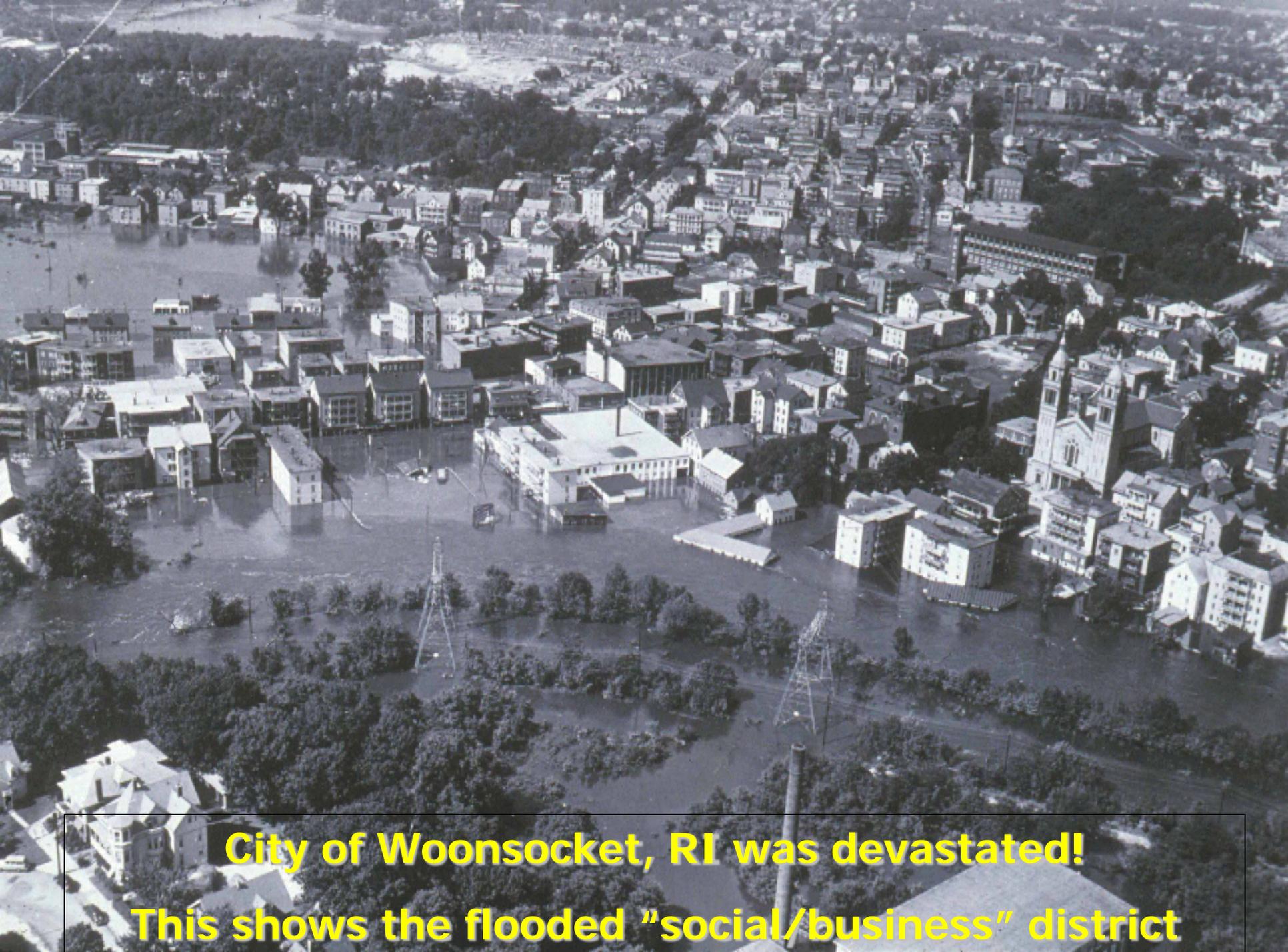


**Route 44 west – Putnam, CT**  
**Before Tropical Storm Diane, 1955**

# Flash Flooding from 12-14 inches of rainfall!



**Route 44 west – Putnam, CT  
After Tropical Storm Diane, 1955**



**City of Woonsocket, RI was devastated!**

**This shows the flooded "social/business" district**

# 1938 HURRICANE – HARTFORD, CT



# 1938 HURRICANE - Winchendon, MA - Millers River



B. SCENE ON MILLERS RIVER AT WINCHENDON, MASS.

Courtesy of International News Photo.



# IRENE FLOODING



Connecticut River – Belows Falls, VT



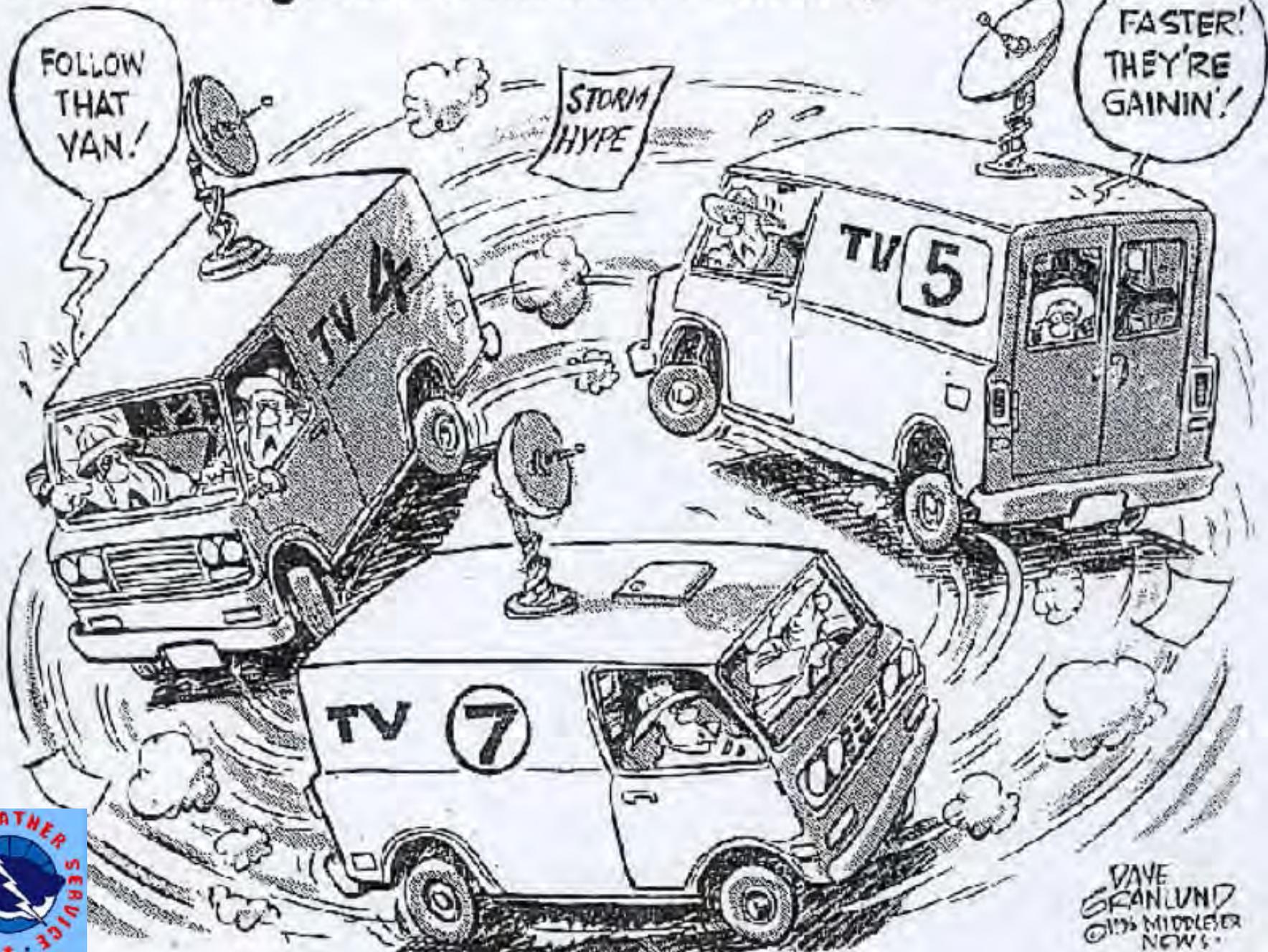
Green River – Leydon, MA

NOW LET'S TALK ABOUT...

***WINDA..***

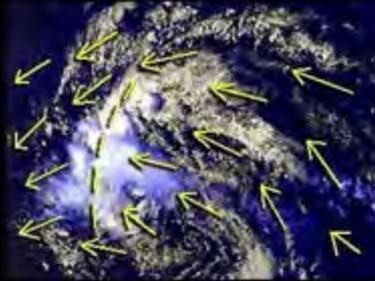


# How rotating hurricane winds develop in N.E...



DAVE GRANLUND  
OHS MIDDLESEX  
NEWS

**Tropical Wave**  
low pressure trough



**Tropical Disturbance**  
broad area of low pressure



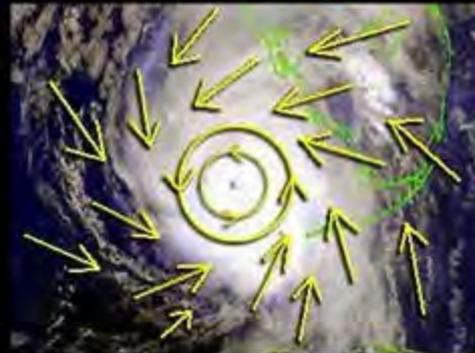
**Tropical Depression**  
maximum sustained winds  
of 38 mph or less



**Tropical Storm**  
maximum sustained  
winds of 39 to 73 mph



**Hurricane**  
maximum sustained winds  
of 74 mph or higher



# Tropical System Definitions



|                   |                     |           |
|-------------------|---------------------|-----------|
| <b>Category 5</b> | – Winds > 155 mph   | (EF3-EF5) |
| <b>Category 4</b> | – Winds 131-155 mph | (EF2/EF3) |
| <b>Category 3</b> | – Winds 111-130 mph | (EF2)     |
| <b>Category 2</b> | – Winds 96-110 mph  | (EF1)     |
| <b>Category 1</b> | – Winds 74-95 mph   | (EF1)     |

Destructive potential of wind increases by the square of the wind speed!

# Saffir-Simpson Scale

| Type                   | MPH | KT  | Energy<br>"Score" | T.S. Factor |
|------------------------|-----|-----|-------------------|-------------|
| Category 5             | 155 | 135 | 2413.4            | 15.8        |
| Category 4             | 131 | 114 | 1723.9            | 11.3        |
| Category 3             | 111 | 97  | 1237.7            | 8.1         |
| Category 2             | 96  | 83  | 925.8             | 6.1         |
| Category 1             | 74  | 64  | 550.1             | 3.6         |
| Severe<br>Thunderstorm | 58  | 50  | 337.9             | 2.2         |
| Tropical<br>Storm      | 39  | 34  | 152.8             | 1           |

"Score" is for each unit mass of air ( $1 \text{ kg} \propto 1 \text{ m}^3$ )

# Kinetic Energy of Wind

# TREE ON A HOUSE DURING BOB

Sustained 40 mph

Gusts 60 mph



# TREES/WIRES DOWN IN GLORIA (1985)

**DON'T GO NEAR ELECTRICAL WIRES!!!!!!**

**G 75-85  
MPH**



# TREES/WIRES DOWN IN GLORIA (1985)

**G 75-85  
MPH**

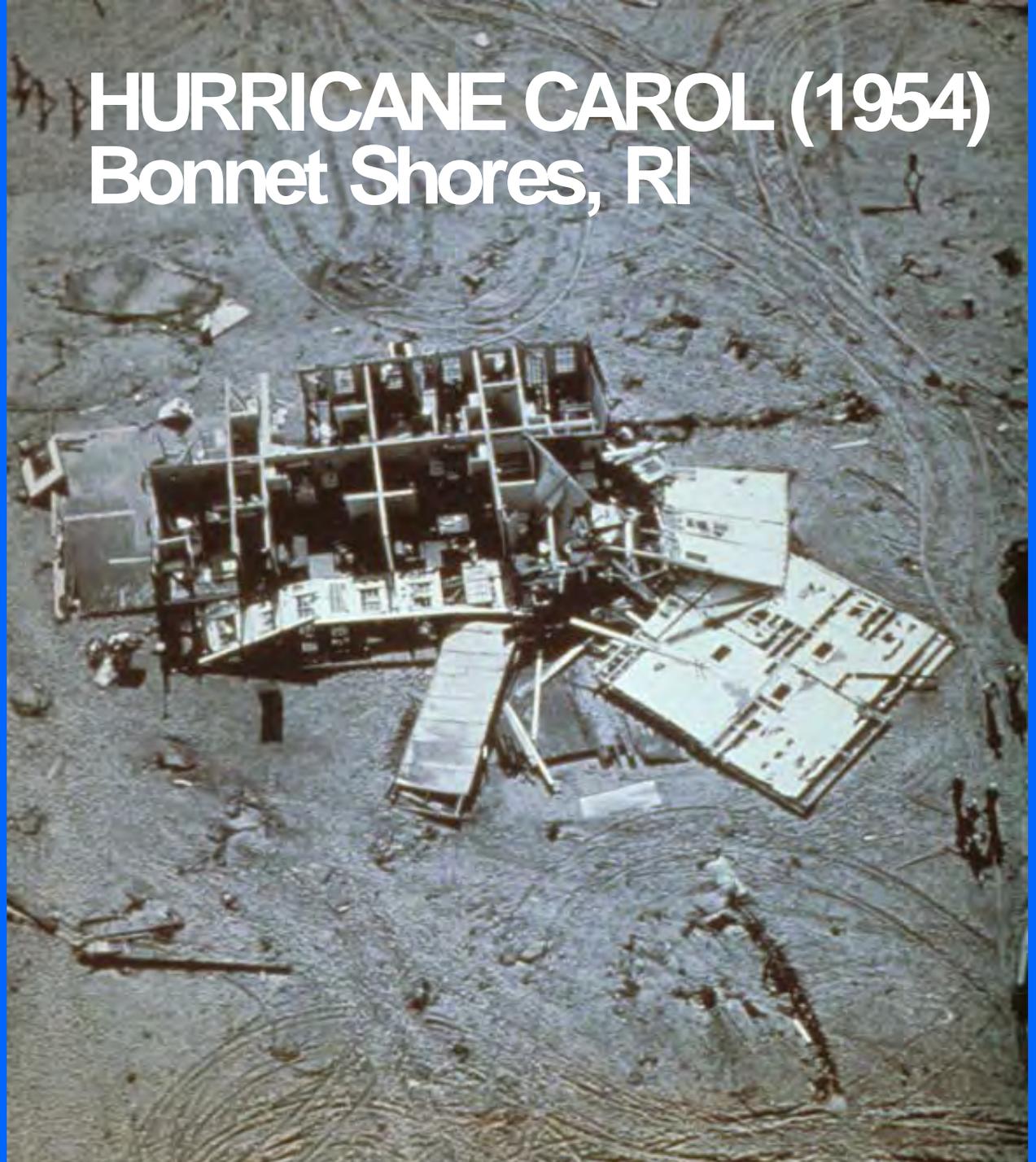


# HURRICANE CAROL (1954)

## Bonnet Shores, RI

**THIS IS  
CAT. 3  
DAMAGE !**

**NOTE THE  
INTERIOR  
ROOMS  
REMAIN  
INTACT**



March 2000  
Ft. Worth, TX  
F2 intensity  
(115-140 mph)  
tornado damage

What about a **Category 3** (111-130 mph)  
hurricane for a half hour?



# Hurricanes & Tall Buildings

# Forest in Falmouth, MA after Bob (1991)



# Martha's Vineyard State Forest a few years after Bob (1991)



TREES DOWNED BY COUNTY  
Hurricane, Sep 1938

|                   |             |
|-------------------|-------------|
| Tolland County    | 29 million  |
| Windham County    | 91 million  |
| New London County | 97 million  |
| Middlesex County  | 14 million  |
| Hartford County   | 7 million   |
| Total             | 238 million |

Source: Connecticut Forest and Park Association Report,  
November 1938



# INLAND WINDS: 1938 HURRICANE

## FACTORY LEVELED IN WOONSOCKET, RI



●WOONSOCKET While most of Rhode Island's loss of life and heavy property damage was charged to the tidal wave the entire State nevertheless felt the full fury of the hurricane. This mill in Woonsocket was almost demolished by the wind, being sheared off at the second floor as if by design as the gale swept through the northern part of the State on its way into Massachusetts.

—Journal photo, Cadoret



# INLAND WINDS: 1938 HURRICANE

ALL THE WAY IN KEENE, NH

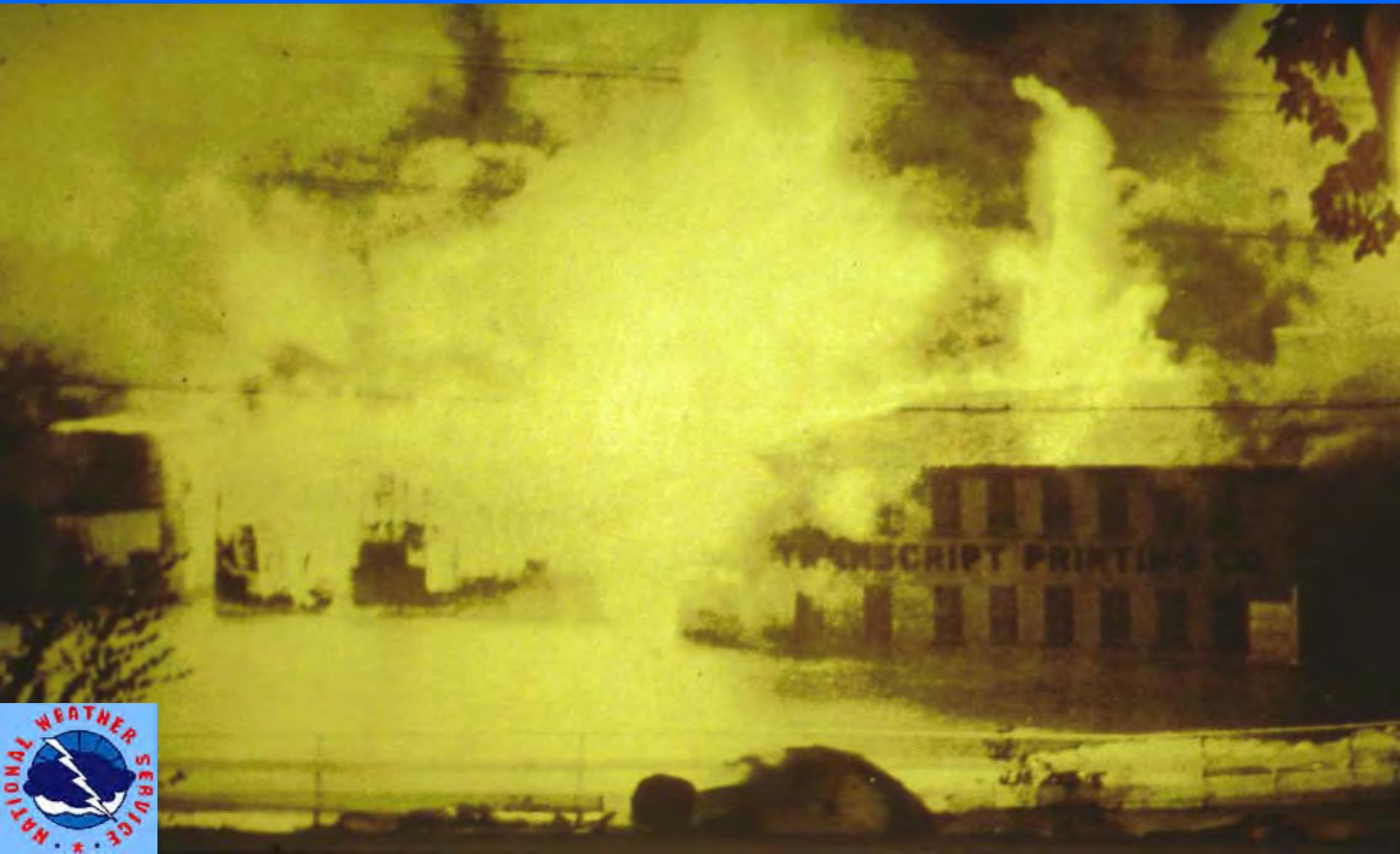


**Sargent Motors in KEENE, NH (brick building)  
DEMOLISHED by 1938 HURRICANE INLAND WINDS**

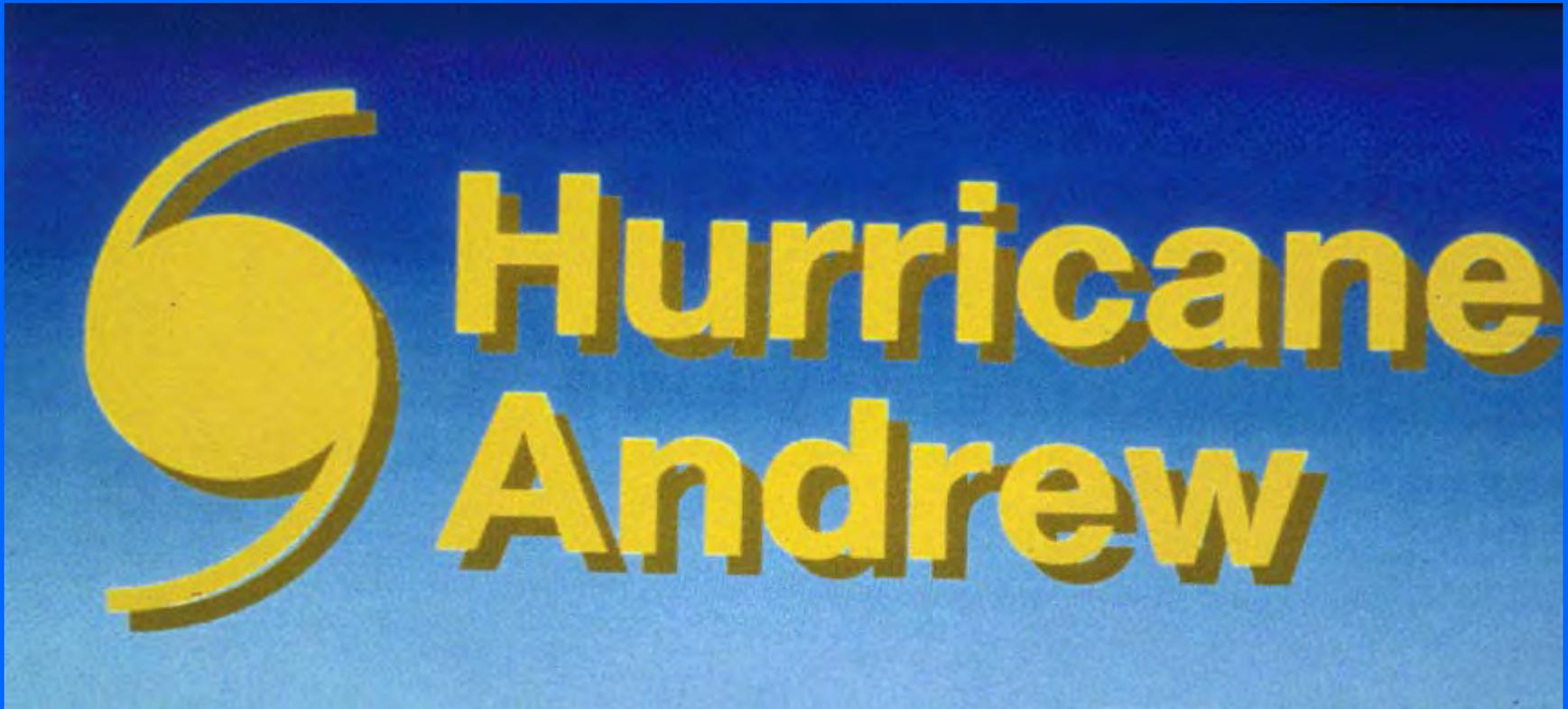


# 1938 HURRICANE: PETERBOROUGH, NH

□ Peterborough Transcript building on fire and flooded out.



# Florida, 1992



(1st of only 5 named storms that year)







# Parking lot at the National Hurricane Center Coral Gables, FL



# Building Modifications – Install Hurricane Clips or Straps



# Do They Work?

Which house had them, and which did not?



# ENHANCED FUJITA TORNADO DAMAGE SCALE

| EF-Scale | Wind Speed |
|----------|------------|
| EF0      | 65-85      |
| EF1      | 86-109     |
| EF2      | 110-137    |
| EF3      | 138-167    |
| EF4      | 168-199    |
| EF5      | 200-234    |

EF0



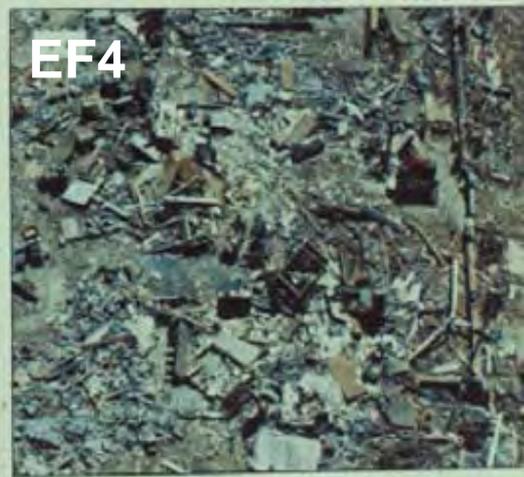
EF3



EF1



EF4



EF2



EF5



# Saffir/Simpson Hurricane Scale

|                            | <u>Category</u> | <u>Definition</u>          |
|----------------------------|-----------------|----------------------------|
| <i>Gloria</i>              | ONE             | Winds 74-95 mph            |
| <i>Bob</i>                 | TWO             | Winds 96-110 mph           |
| <i>Carol, 1938</i>         | THREE           | Winds 111-130 mph          |
| <i>Hugo</i>                | FOUR            | Winds 131-155 mph          |
| <i>Camille,<br/>Andrew</i> | FIVE            | Winds greater than 155 mph |



# THE DODGER DOG WIND SCALE

**CATEGORY 0:**  
NEAR CALM



**CATEGORY 1:  
10-20 mph**



**CATEGORY 2:  
25-35 mph**



**CATEGORY 3: 40-50 mph**

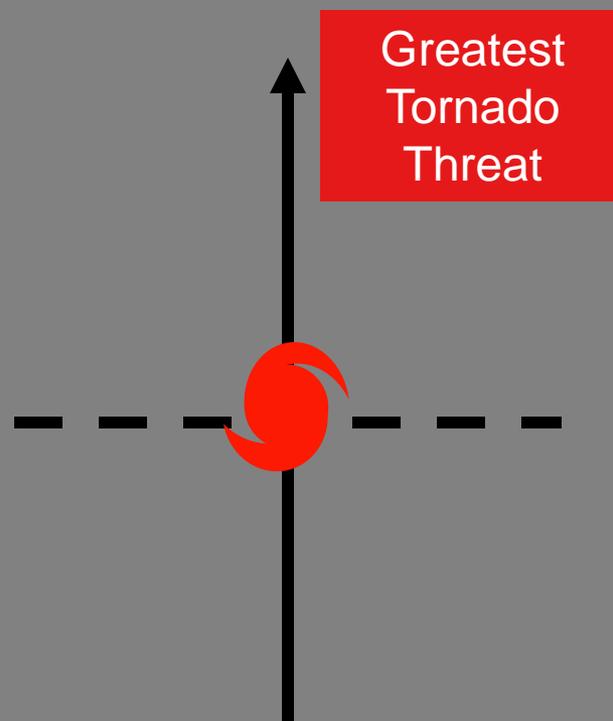


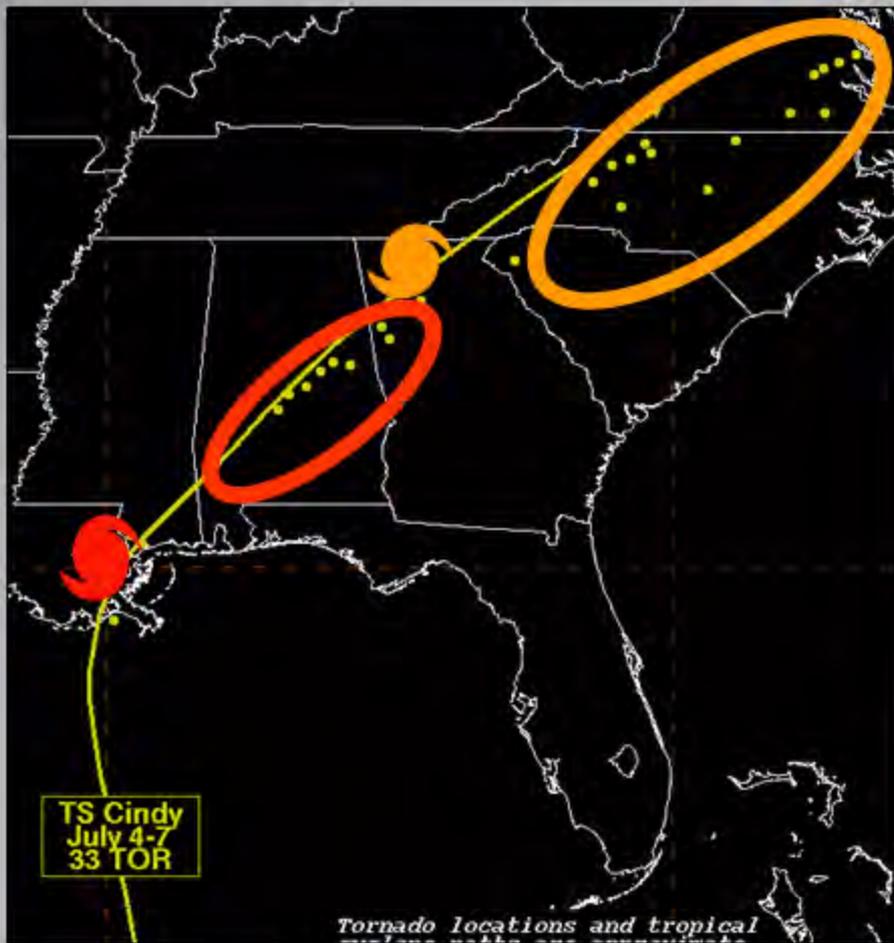
**CATEGORY 4:  
100 mph**



# Tornadoes

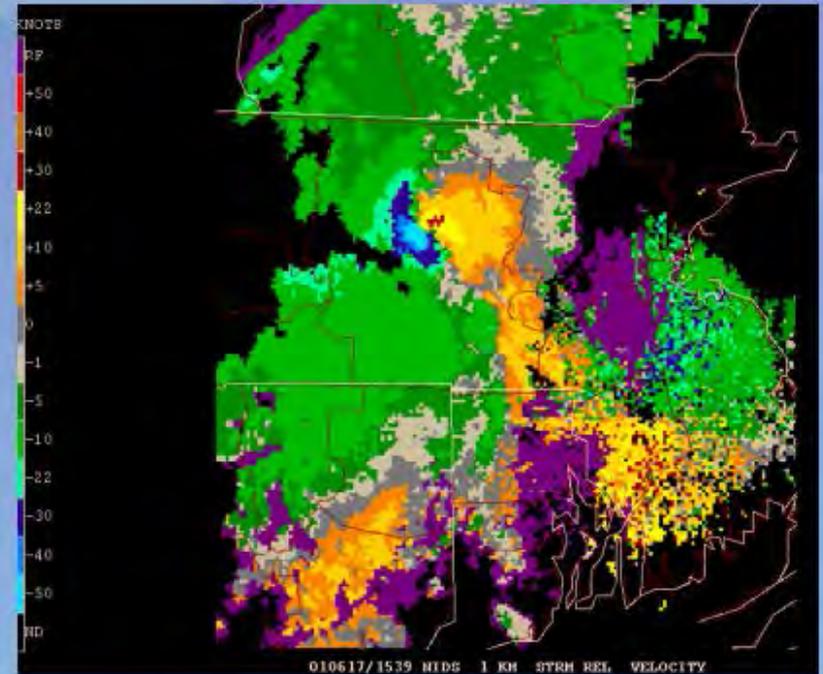
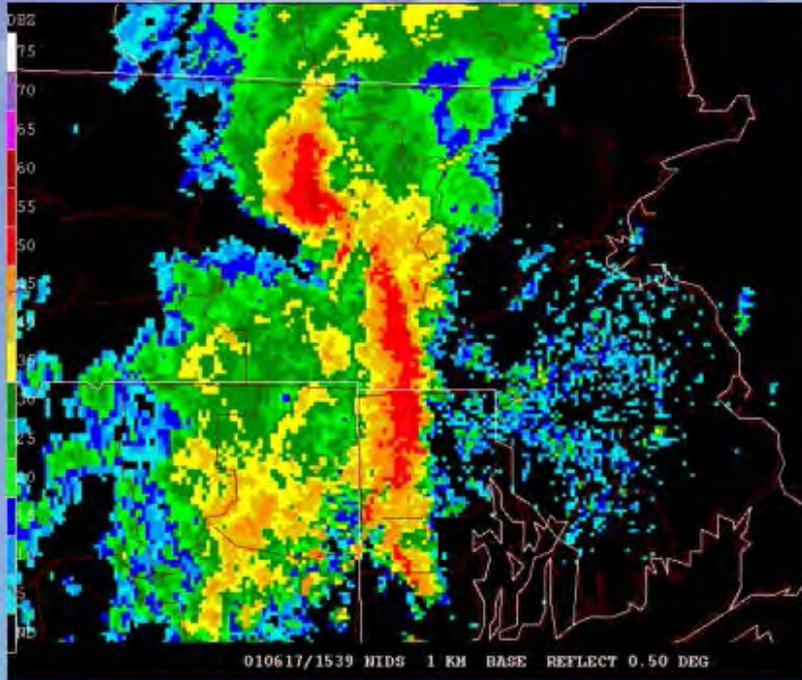
- Almost all tropical systems produce at least one tornado or waterspout!
- Tornadoes can form hundreds of miles ahead of a tropical storm or hurricane
- 90% of these tornadoes or waterspouts develop in the “right front” quadrant





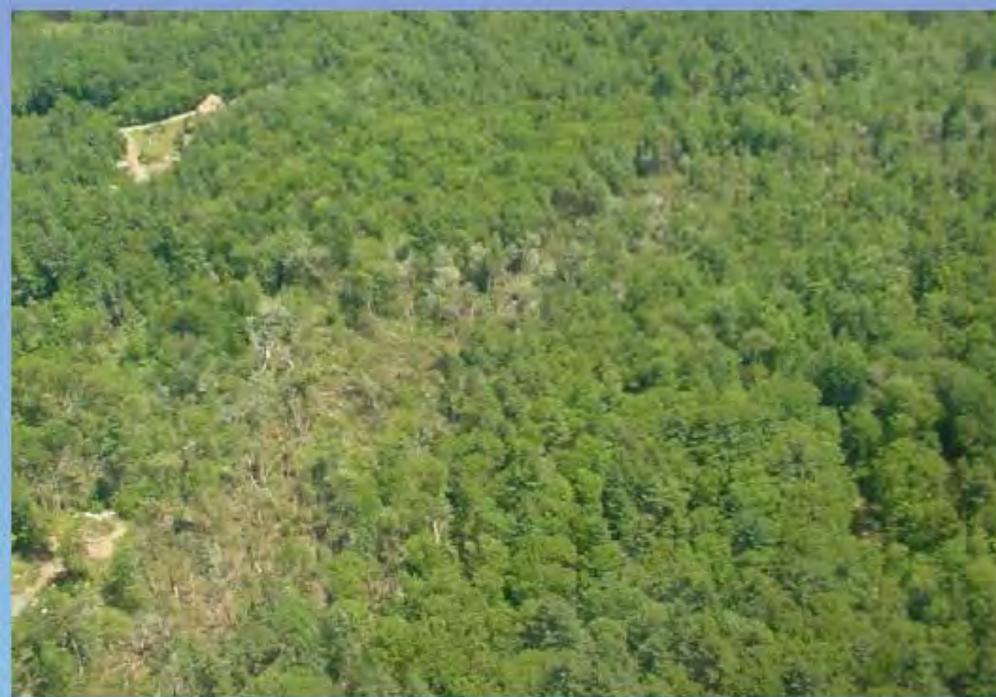
# Tornadoes in Cindy and Dennis (2005)

# Princeton, MA - F1 Tornado - June 17, 2001



# Princeton, MA - F1 Tornado - June 17, 2001

Aerial survey showed a coherent track, up to a max. of 1700 feet wide. It stopped short of houses! No injuries were reported.



The tornado resulted from a combination of convergence along an advancing cold front and the northernmost outer fringes of the remnants of Tropical Storm Allison, which was located just south of Long Island, NY at the time.

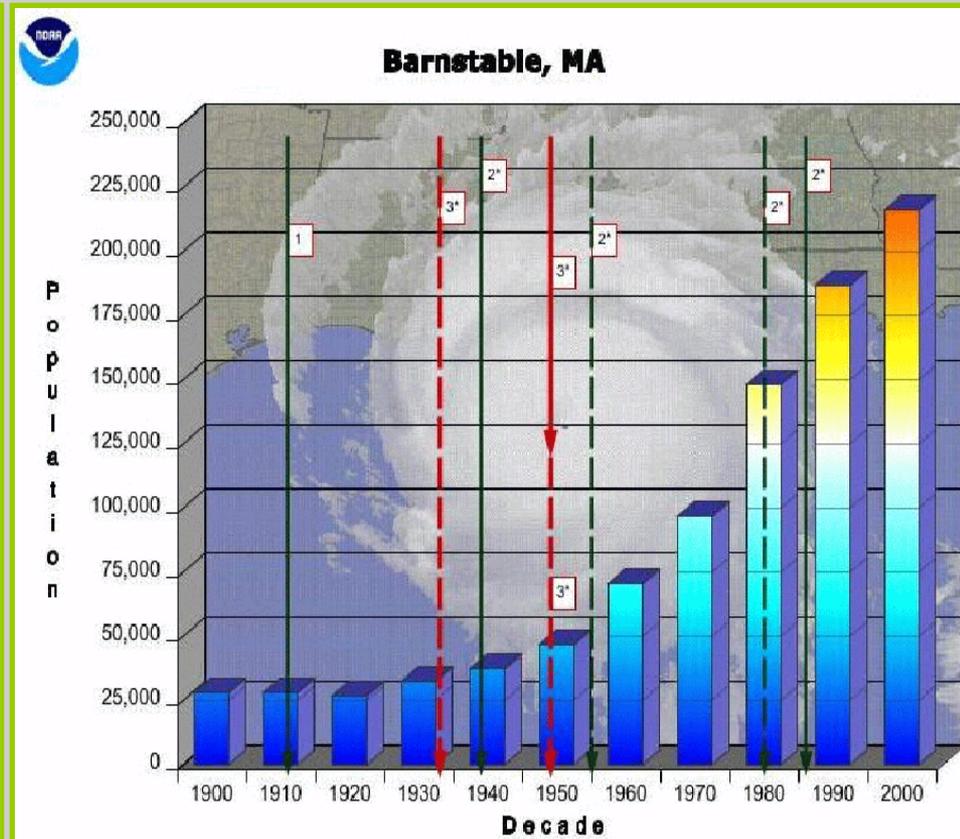
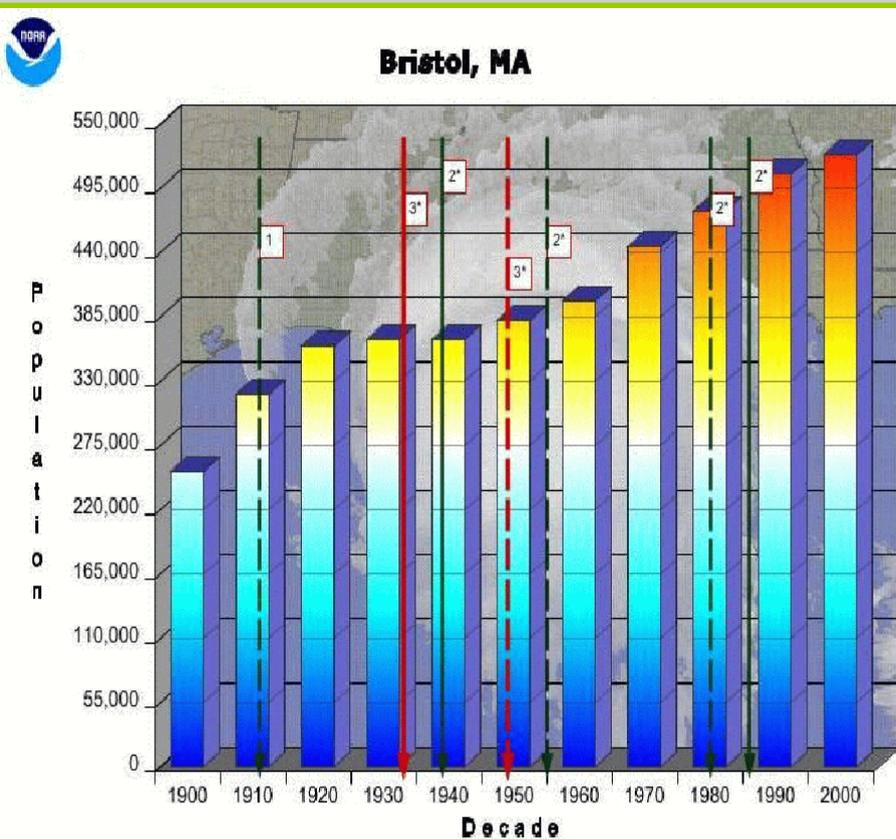
NOW LET'S TALK ABOUT...

# ***STORM SURGE...***



# Why Is Surge Important?

- It can kill you & cripple coastal communities
- >50% of U.S. economic productivity - coast!
- Big population increase on our coast since '54



# Misquamicut Wiped Out; Napatree Point Gone; 50 Dead; Scores Missing

## Westerly Paralyzed by Tropical Hurricane; Cottages at Charlestown Beach and Quonochontaug Washed Away; 4 Dead, 4 Missing In Stonington

Misquamicut with 500 cottages, was entirely wiped out, all cottages on Napatree Point, Watch Hill, destroyed and more than 50 people killed and millions of dollars of property damage resulted from a tidal wave and hurricane which struck Westerly late Wednesday afternoon.

Charlestown Beach and Quonochontaug likewise were destroyed.

Westerly and the Rhode Island shore received the brunt of the force in New England, more deaths being reported in this locality than any other.

Records show that just 123 years ago to the day, September 23, a hurricane struck Westerly.

Fawcett Overflows

The ocean backed up the Fawcett River...

### List of Dead and Missing

#### Bodies Recovered

- Mrs. Henry Bennett, New York City
- Mrs. Ella Bliven
- Mrs. Ralph Bliven, Misquamicut
- Mrs. George Bradley
- Mrs. Byron Button
- Mrs. R. N. Byrnes
- Mrs. George P. Clark, Shannock
- Miss Harriet Clark, Shannock
- Miss Ann Clark, Shannock
- Miss Florence Clark, Shannock
- Miss Phillip Clemens
- Mrs. Lloyd M. Cook
- George Cross, Charlestown
- Mrs. George Davidson
- Mrs. Dnamore
- Mrs. Zoe Fletcher
- Father Fitzgerald
- Mr. James Gould

- Mrs. Kingsbury
- Mrs. Raybacker
- Evelyn Bliven
- Mr. Bunce
- Ethel Crooker
- Frank Passetti
- Mrs. John Davidson
- Amos Burdick
- Mrs. Amos Burdick
- B. L. Lamphear
- Mrs. Meed and two children
- Mrs. William Bliven
- Two small Moriarty children
- Mrs. P. Hopley
- Agnes S. Herrick
- Catherine Culley
- Della O'Toole
- Frances O'Toole
- Ethel Avery

Every one of the approximately 200 houses on Charlestown Beach was carried away.

Between 75 and 100 houses on the Charlestown Pond area including Charlestown-by-the-Sea were demolished. The few houses left in that area have been moved from a few feet to a quarter of a mile away. A few houses on hill pastures are not as badly damaged. Many people who were staying in that section just barely escaped.

Mrs. David Larkhan and daughter who were on the beach started across the Pond on a door. Mrs. Larkhan washed away, but Miss Larkhan was saved, although she is in a poor condition.

Mr. Mee and family were in their car, leaving the beach, and stopped to assist the Breckinridge family who were in trouble. The wave...

# Misquamicut, RI – 1938

BEFORE...



*Looking Toward Weekapaug From Atlantic Beach Casino*

MISQUAMICUT—The storm-swept stretch below is all that is left of the once-busy central section of Atlantic Avenue (shown above) from the Town Beach Parking Grounds continuing towards the Dunes.

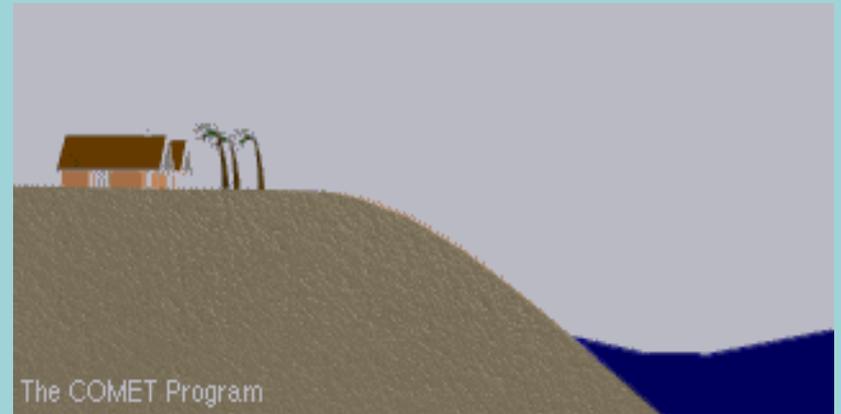
AFTER...







**Shallow Shelf Incline**



**Steep Shelf Incline**

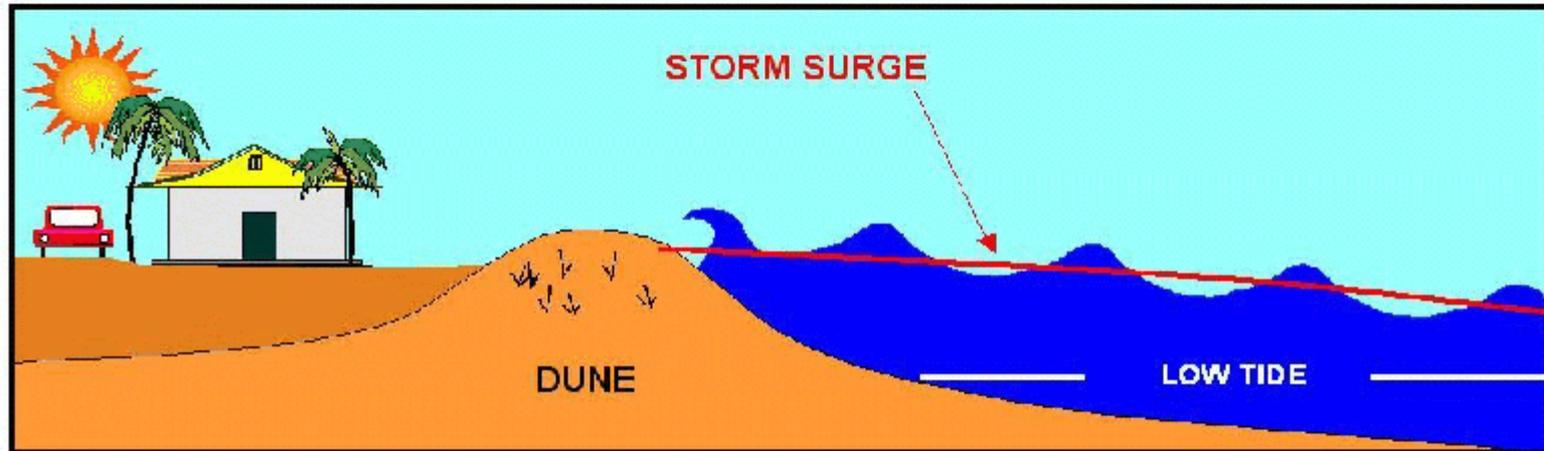
- Shallow shelf – results in higher surges and lower waves
- Steep shelf – results in lower surges and higher waves

# Storm Surge and Shore Slope

# A Preparedness Challenge

- No Category 3 hurricanes have made landfall in southern New England since 1954
  - **And no hurricane at all since 1991**
- Buildup in coastal population and infrastructure presents a high risk for life and property
- Most New Englanders have not experienced a worst case scenario and many no hurricane at all!
  - **Inexperienced population!**

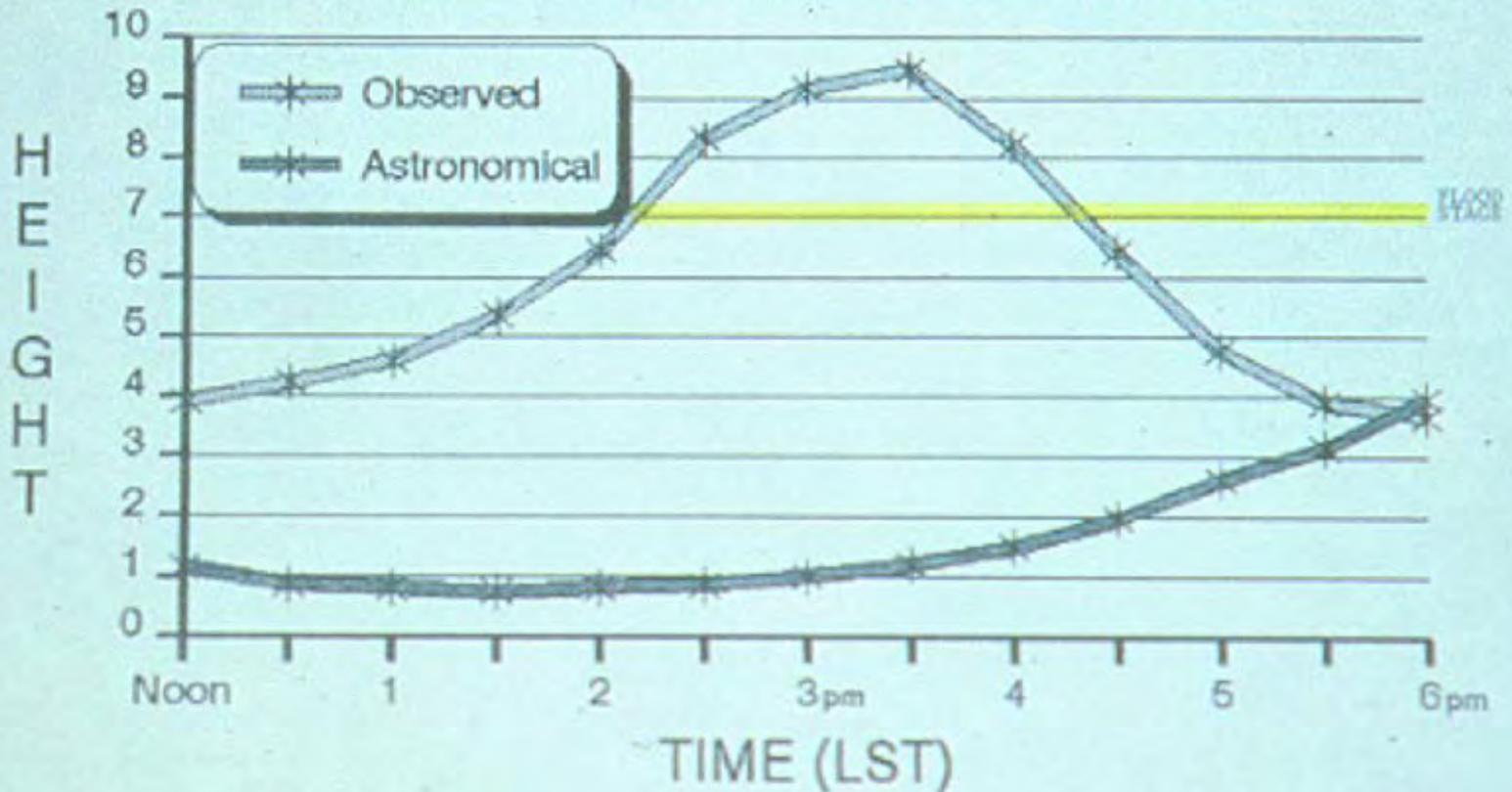
# LOW TIDE



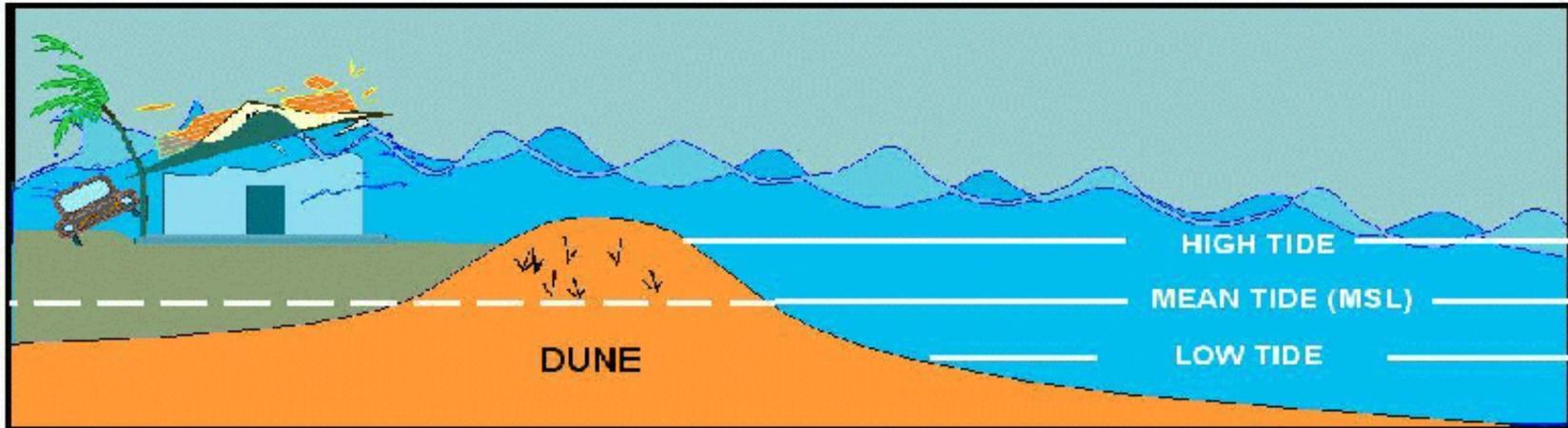
# GLORIA CAME AT LOW TIDE !!!

## Hurricane Gloria — 1985

Fox Point Barrier Tide Data in MLLW



# HIGH TIDE



# DOWNTOWN PROVIDENCE – Westminster Street 1938 HURRICANE



# Onset During 1938 Hurricane

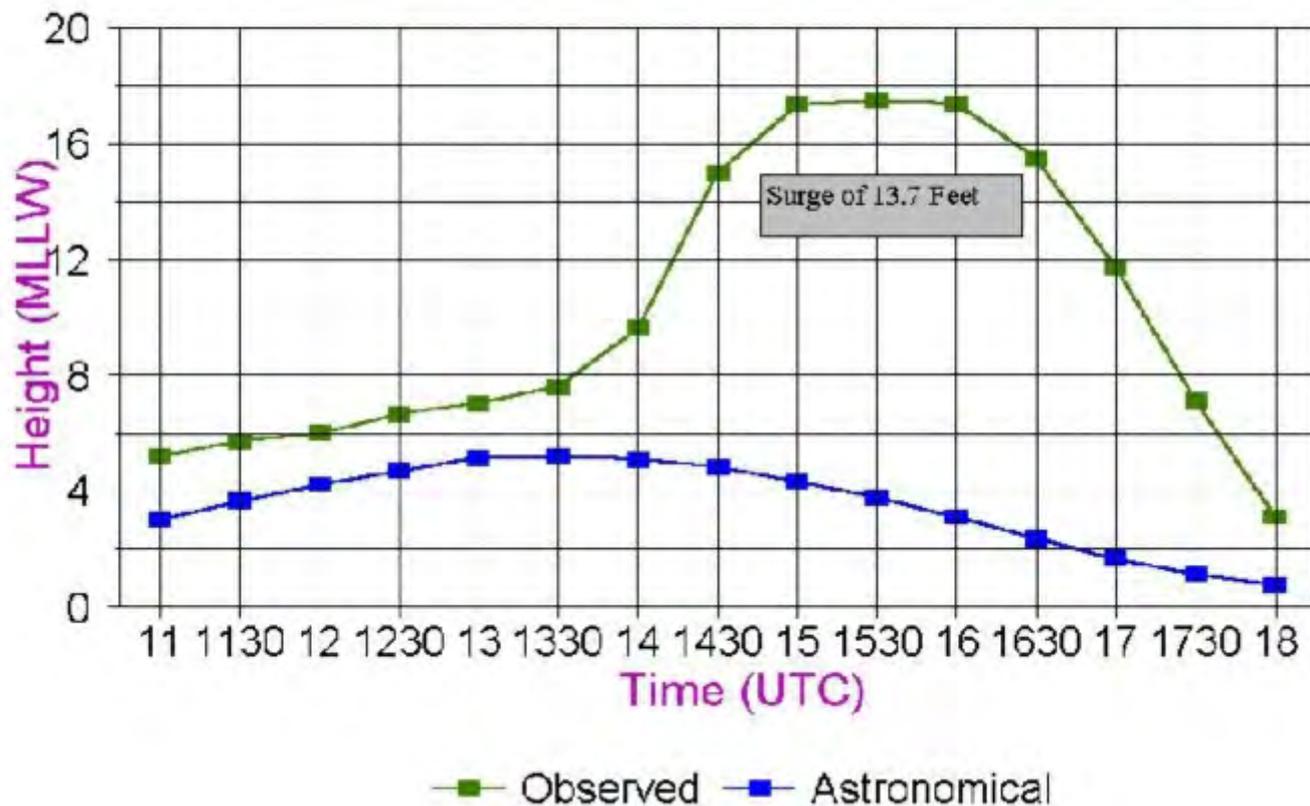


☐ CAROL ARRIVED ON A DECLINING TIDE

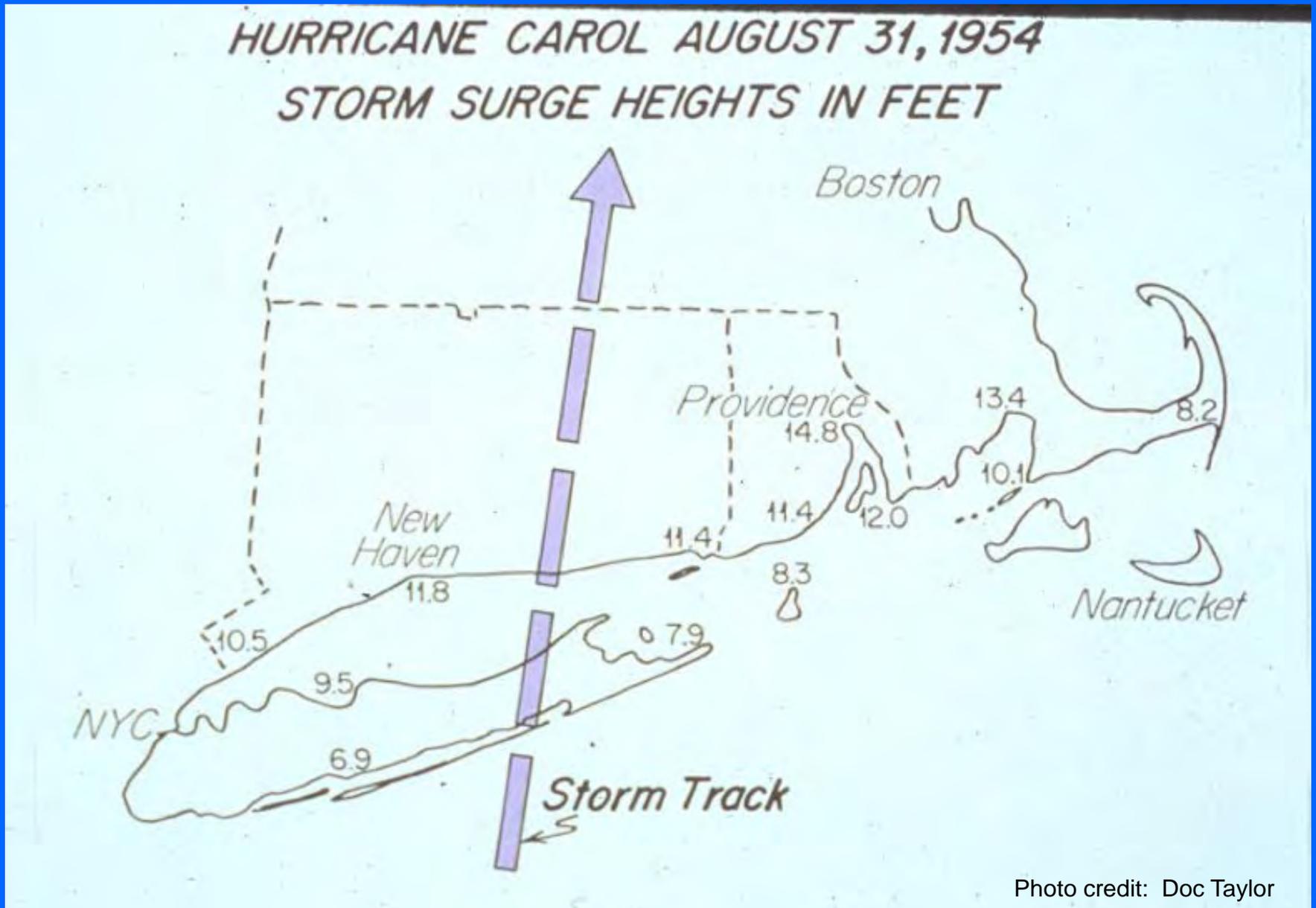
☐ FLOODING COMMENCED 4 HOURS BEFORE  
MAXIMUM STORM SURGE

## HURRICANE CAROL STORM SURGE

Fox Point, RI, August 31, 1954



# Carol's track (1954) only produced 13 ft. at Buzzards Bay



# HURRICANE CAROL - 1954



**Crescent Beach, MASSACHUSETTS.... BEFORE**

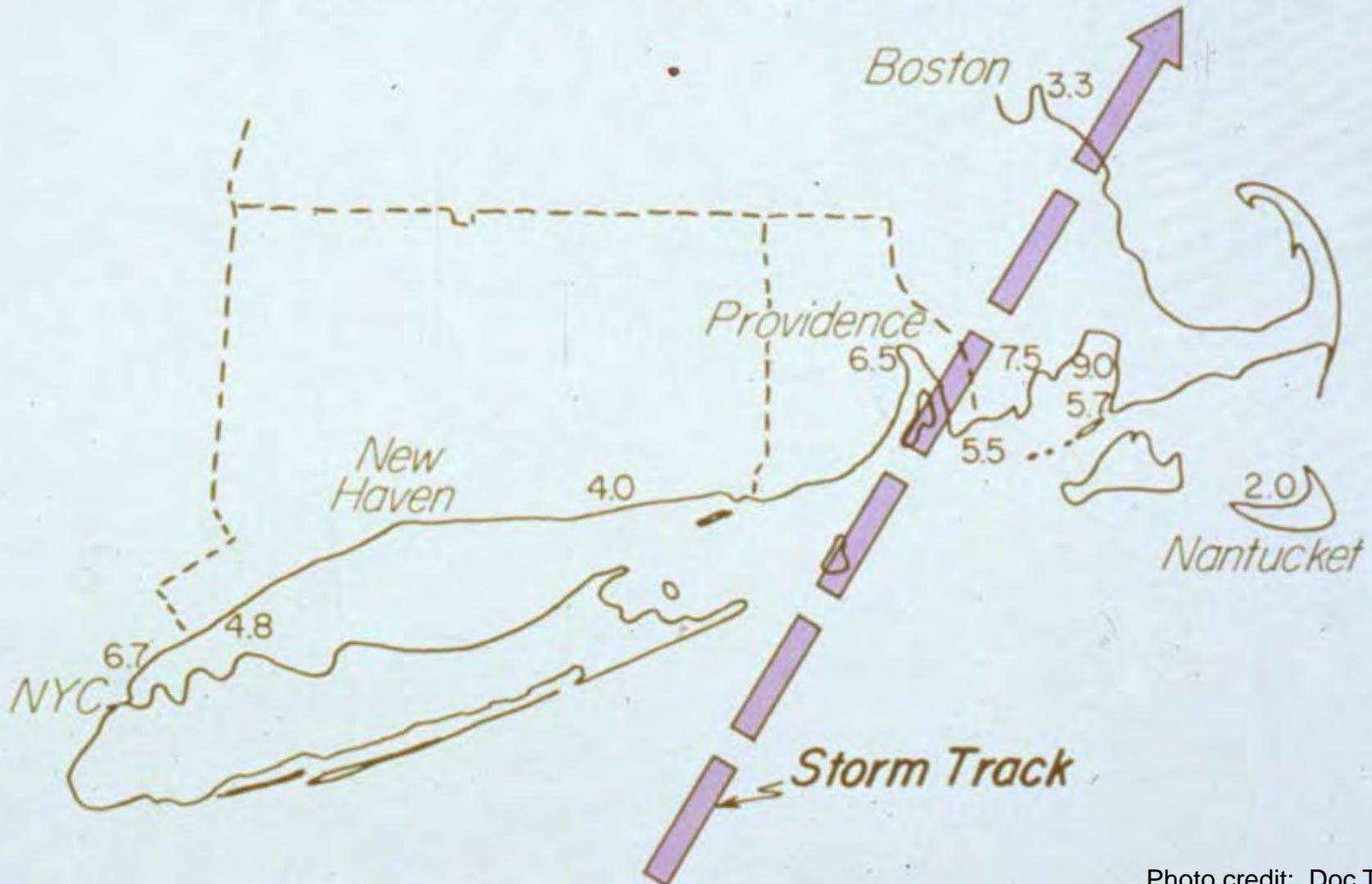
# HURRICANE CAROL – 1954



**Crescent Beach, MASSACHUSETTS . . . . AFTER**

# HURRICANE BOB (1991) GENERATED 6 TO 9 FOOT SURGE IN BUZZARDS BAY

HURRICANE BOB AUGUST 19, 1991  
STORM SURGE HEIGHTS IN FEET



# Bob, 1991: Falmouth, MA



Photo credit: Doc Taylor

# IN MENAUAHANT SECTION OF FALMOUTH, MA



# THE BALCONY; THE SEA WALL

(**Before** Hurricane Bob's 6 foot surge)



Photo credit: Doc Taylor

...**DURING** Bob's 6 foot storm surge...



Photo credit: Doc Taylor

# SLOSH

**SEA, LAKE AND  
OVERLAND SURGE  
FROM HURRICANES**

**COMPUTER MODEL  
FROM NATIONAL HURRICANE CENTER**

ANALYZED SLOSH MODEL STORM  
SURGE HEIGHTS\* FOR:

**MEOW-NORTH-60MPH-C3**

\*ONE FOOT CONTOUR INTERVALS HEIGHTS RELATIVE TO  
MEAN SEA LEVEL DATUM (1929)



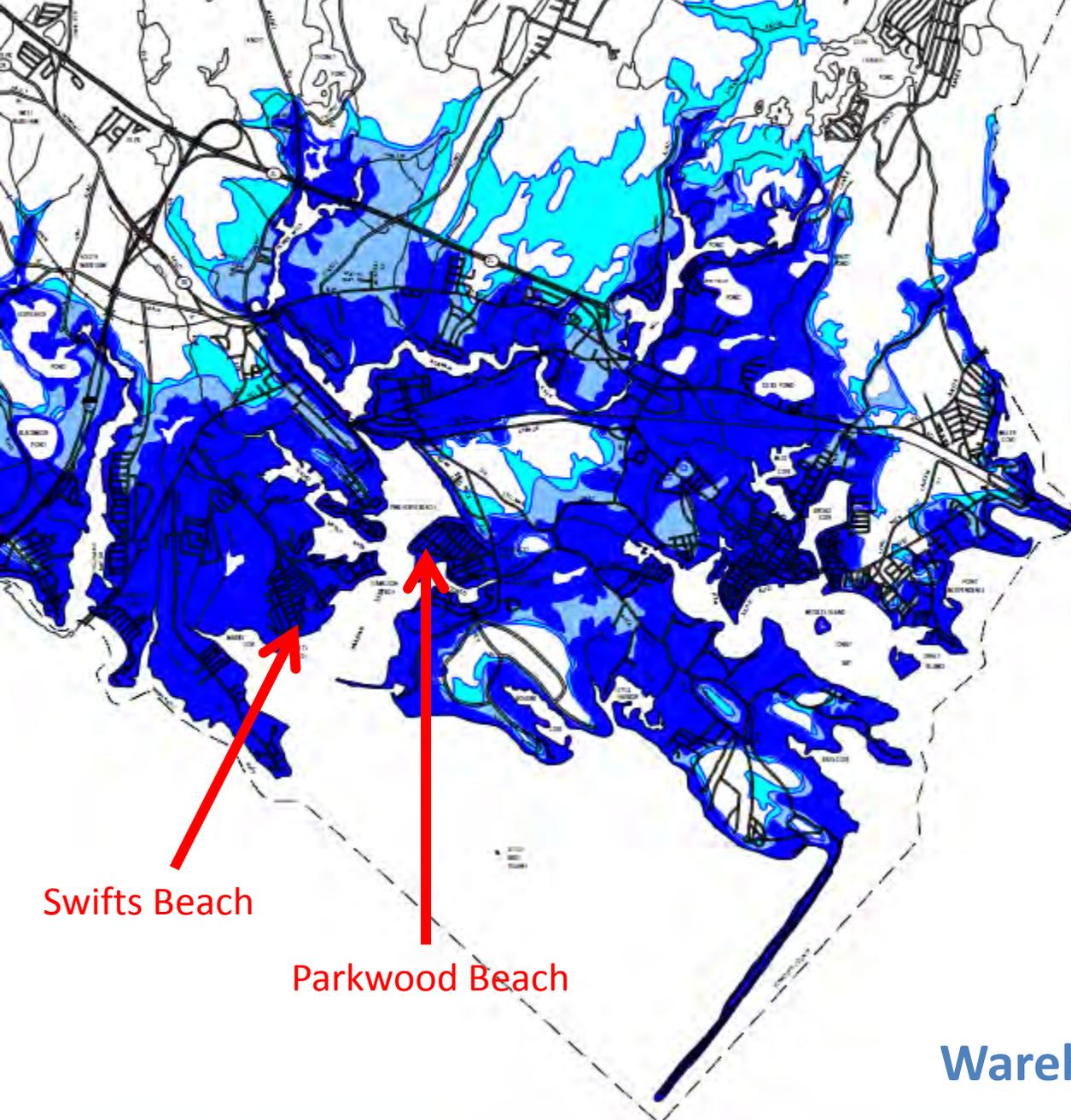
Parkwood Beach  
Wareham, MA

24' surge on mean high tide

17' surge on mean high tide

7' surge on mean high tide





Swifts Beach

Parkwood Beach

Wareham

HURRICANE INUNDATION AREAS

- Inundation Area A
- Inundation Area B
- Inundation Area C

NOTES:

1. Inundation areas were derived from the National Hurricane Center's application of the SLOSH plus Lake and Overland Surge from Hurricanes model. Inundation areas reflect "WORST CASE" combinations of hurricane direction, forward speed, landfall point, and high astronomical tide.
2. Hurricane categories 1 through 4 refer to the Saffir-Simpson scale of hurricane severity.
3. Shaded land areas represent areas with coastal flooding potential from hurricanes of the category and forward speeds reflected by the inundation matrix shown above. Inland areas that may only be subjected to freshwater flooding are not identified.
4. "WORST CASE" hurricane surge elevations delineated for each inundation area are given in the surge tide profiles provided on file.

LOCATION MAP

EASTERN MASSACHUSETTS



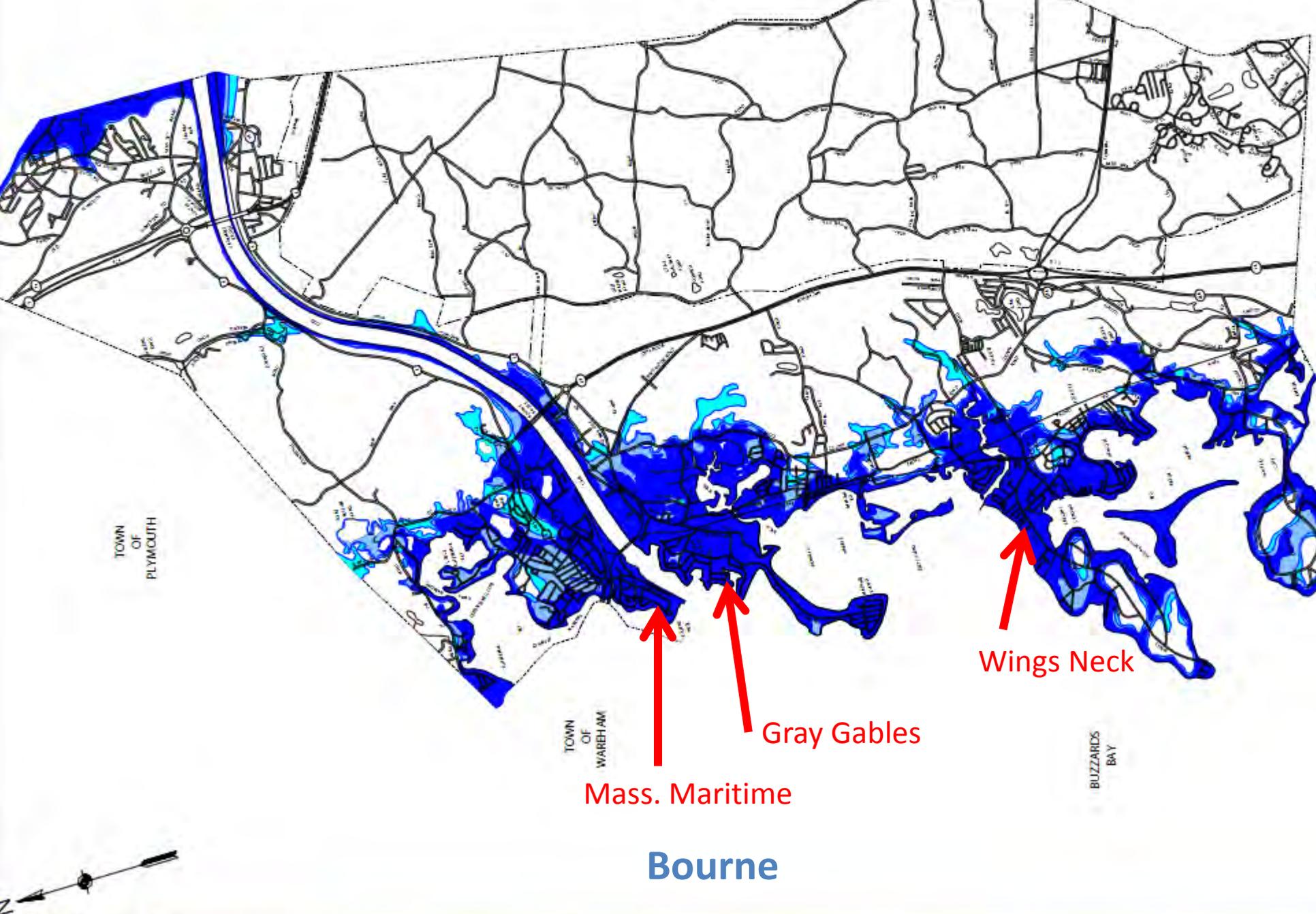
COMMONWEALTH OF MASSACHUSETTS  
HURRICANE EVACUATION STUDY  
INUNDATION MAP

TOWN OF **WAREHAM**  
COUNTY OF **PLYMOUTH**

Prepared by the U.S. Army Corps of Engineers, New England Division in cooperation with the Federal Emergency Management Agency, Region 1.

# Potential for 25+ feet of Surge at Gray Gables





TOWN OF PLYMOUTH

TOWN OF WAREHAM

BUZZARDS BAY

Mass. Maritime

Gray Gables

Wings Neck

Bourne

8.50 x 11.00 in

# Flooded Car in Wareham/Bourne Area

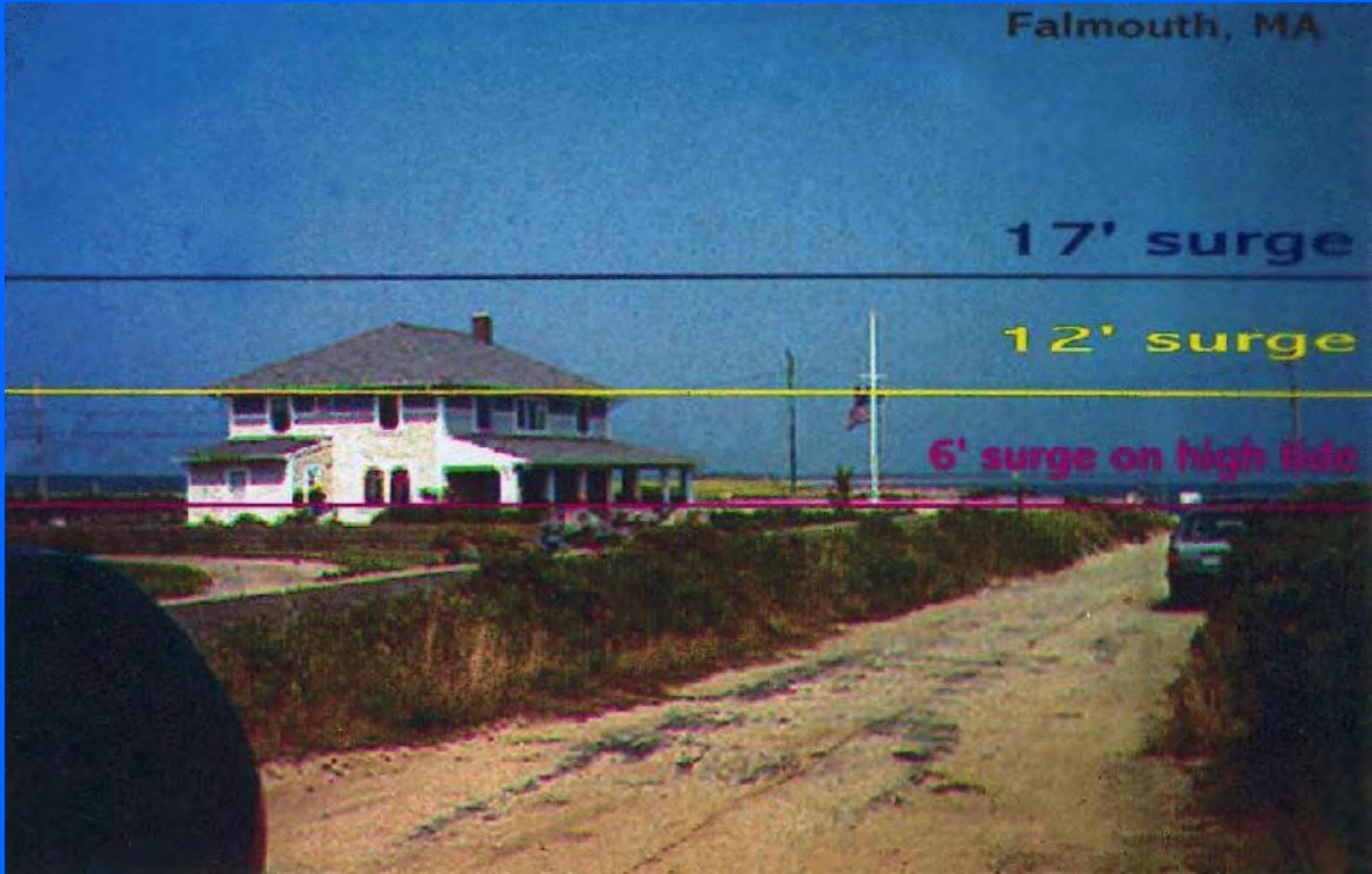


**1938 Hurricane**

# 1938 Hurricane High Water Mark Sign

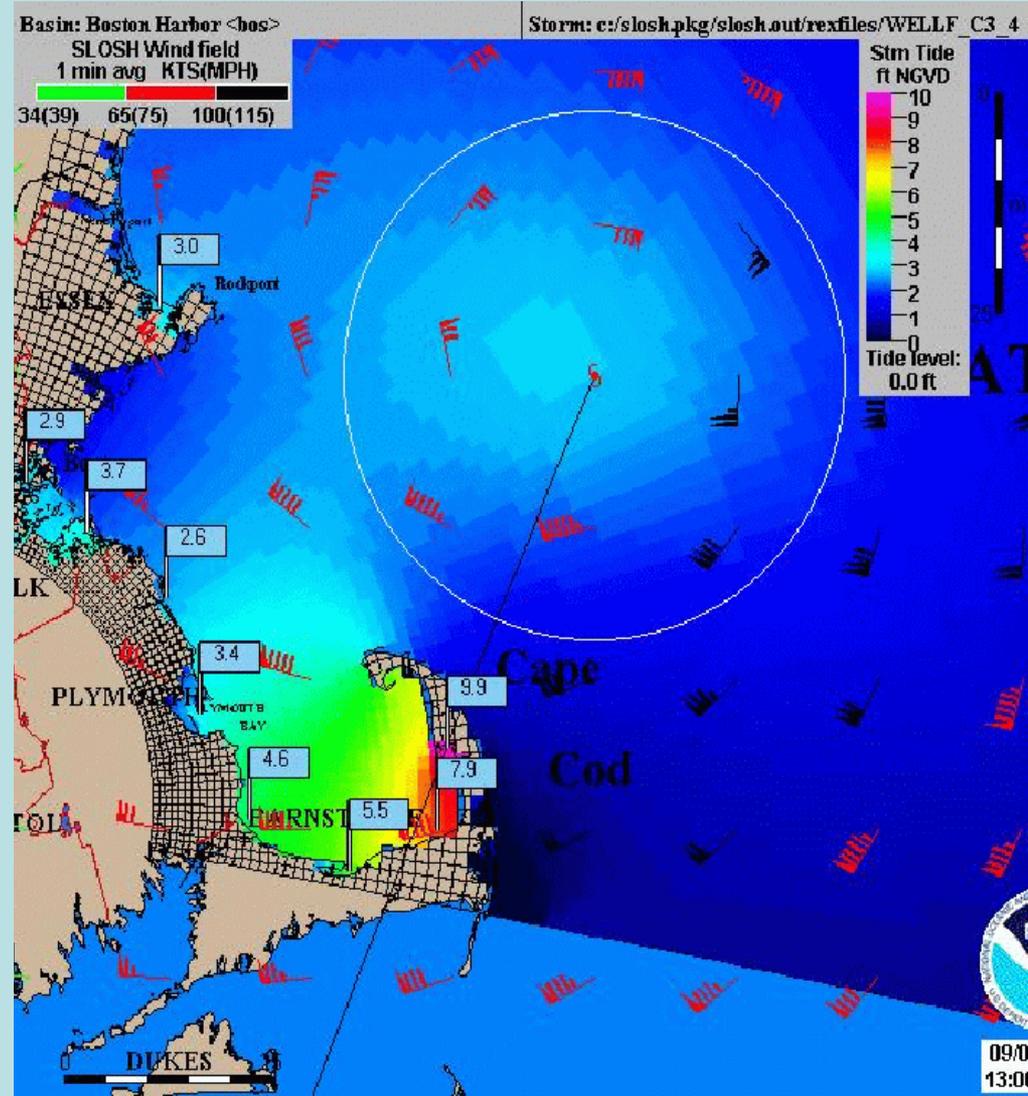


**A Carol or 1938 Hurricane on worst case track could produce about 14 feet of surge here**

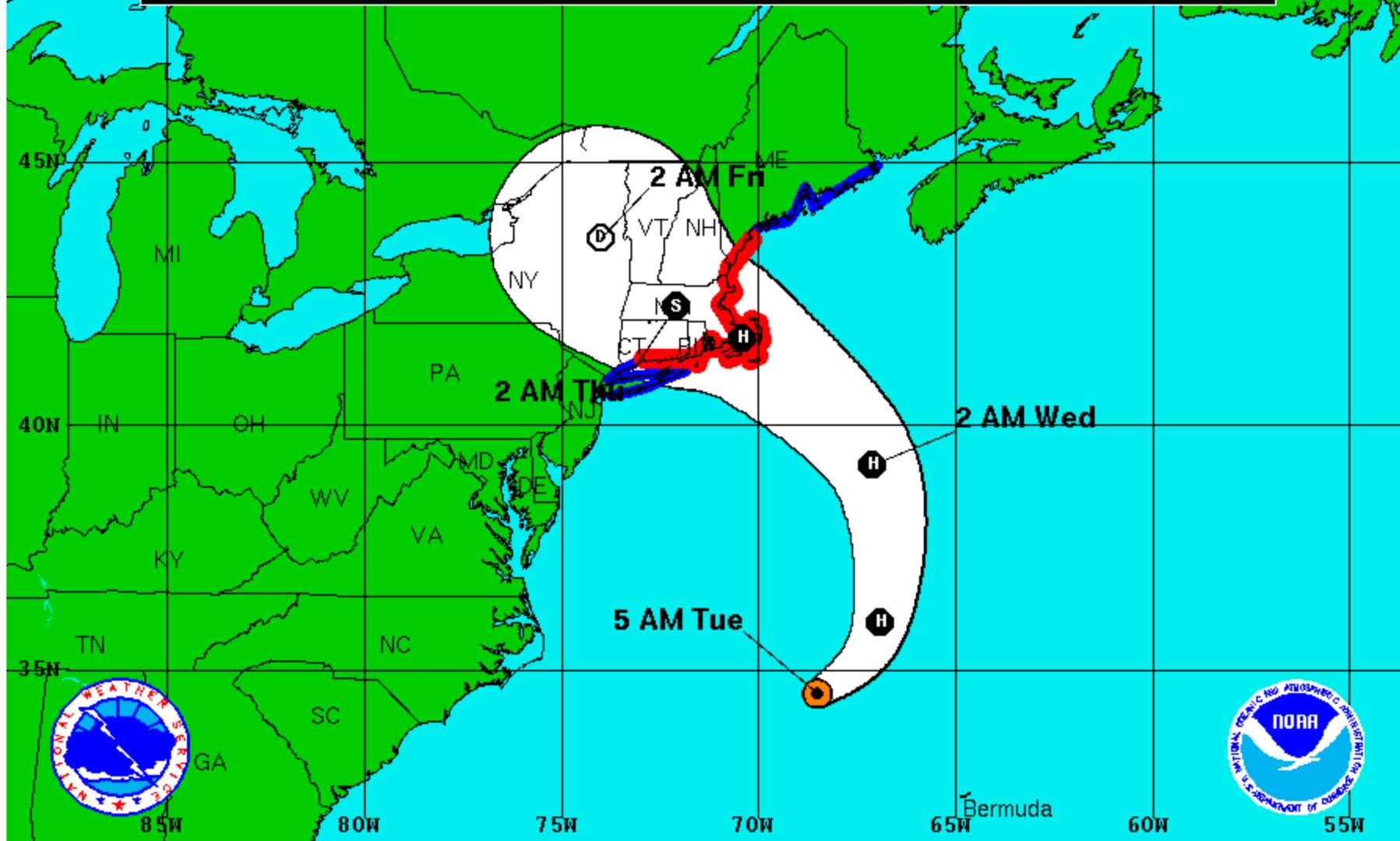


# For eastern Massachusetts: Max surge occurs after the center passes!

- Simulation for Hurricane Edna, 1954
- Note the surge of ~10 feet in Wellfleet Harbor - occurs nearly 1.5 hours after the eye reaches the south side of the cape!



Note: The cone contains the probable path of the storm center but does not show the size of the storm. Hazardous conditions can occur outside of the cone.



**Hurricane Travis**

Tuesday October 27, 2015  
 5 AM EDT Advisory 18  
 NWS National Hurricane Center

**Current Information:**

Center Location 34.5 N 68.5 W  
 Max Sustained Wind 75 mph  
 Movement NE at 15 mph

**Forecast Positions:**

Tropical Cyclone Post-Tropical  
 Sustained Winds: D < 39 mph  
 S 39-73 mph H 74-110 mph M > 110mph

**Potential Track Area:**

Day 1-3

**Watches:**

Hurricane Trop.Storm

**Warnings:**

Hurricane Trop.Storm

# Hurricane Inundation Zones

Category 1 Category 2 Category 3 Category 4

**Planning Tool: Worst case scenario inundation for each category hurricane**



# Wave Action

Scene from Woods Hole, MA – 1938 Hurricane



© 1938

Copyrighted Photo by Linnfield A. Baker, U.S. Marine Biological Laboratory, Woods Hole

**WOODS HOLE**

U. S. Fishery Building during the Hurricane.

# Sandy's Impact on the RI Coast

- Storm surge of 4 to 5 feet
- Huge waves
  - Over 45 feet offshore
  - Breaking waves at shoreline over 25 feet



# Sizable areas with about 4 feet inundation



# But most impressive of all...the complete erosion of the oceanfront dune



# And depositions in and behind ocean front homes/businesses



# Where did these come from?



**Cars buried when  
dunes were  
reconstructed after  
Carol in 1954!**



**...lower your masts...**

**...majority were at least salvageable**



# Pawtuxet Cove, RI: 250 boats destroyed in one marina alone (1938 Hurricane)



**You feel safe because your boat is tied to  
SLIP-RING MOORINGS ?**



**THEY DON'T WORK !**

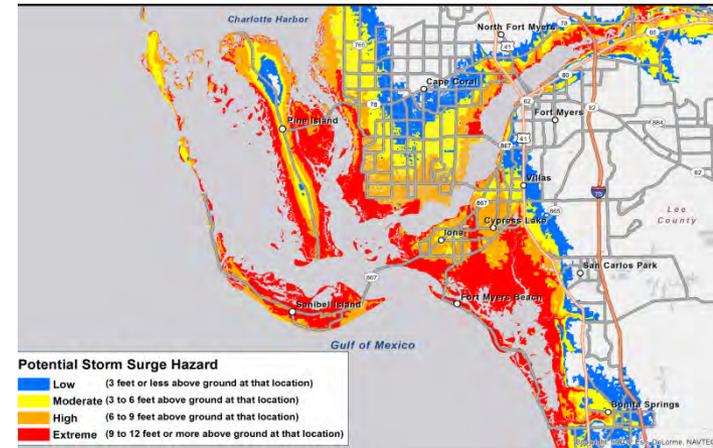
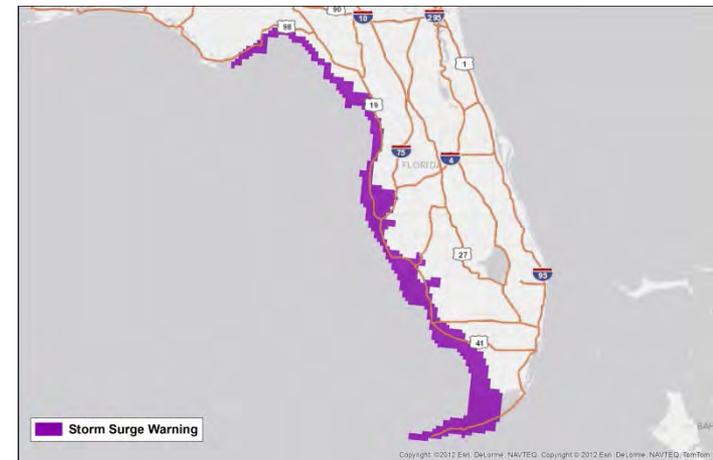


**... OR LINES CAN CHAFE ...**



# New Developments from National Hurricane Center

- Storm Surge Warnings
  - Explicit Storm Surge Warning
    - versus implicit by a Hurricane Warning
  - Recommended by social scientists
  - Experimental in 2015
- Dynamic inundation mapping
  - Visualization of inundation **possible** from a specific storm
  - Represents plausible worst case scenario (10% exceedance)
  - Does not incorporate wave runup/overwash
  - Currently only for tropical cyclones





- Can occur more than 1000 miles in advance of a tropical system – depends on size and intensity
- Often can catch people unaware of the risk because the weather is not “bad” at a particular location
- Shallow beaches perpendicular to swell motion most at risk

# Rip Currents



# Putting Seasonal Forecasts in Perspective

- If a perfect seasonal forecast predicts
  - 8 Named Storms**
  - 3 Hurricanes**
  - 1 Major Hurricane**

- Do you think it is going to be a bad year?

- THAT WAS THE 1938 SEASON.

# Putting Seasonal Forecasts in Perspective

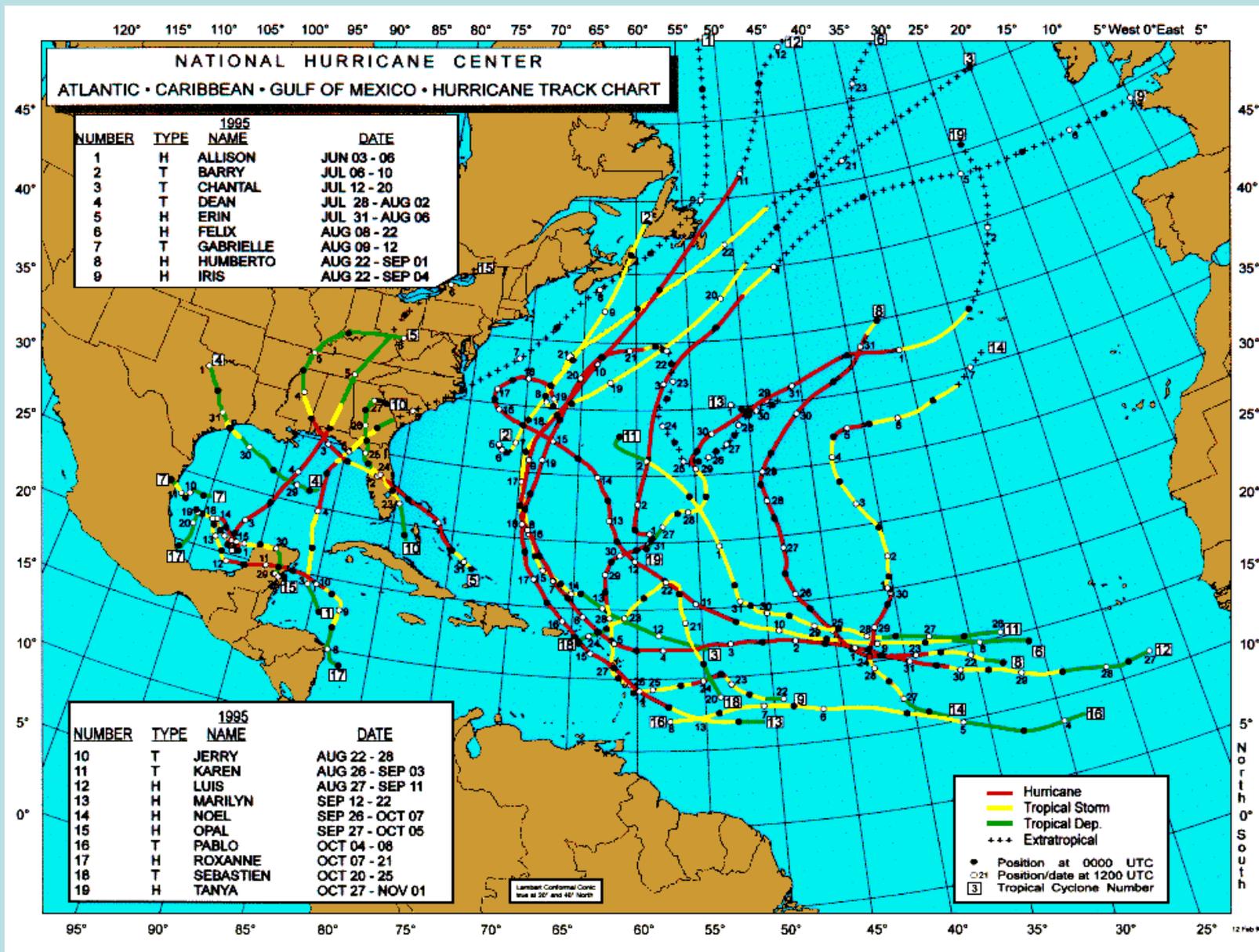
- If a perfect seasonal forecast predicts
  - 7 Named Storms**
  - 4 Hurricanes**
  - 1 Major Hurricane**

- Do you think it is going to be a bad year?

- THAT WAS THE 1992 SEASON...

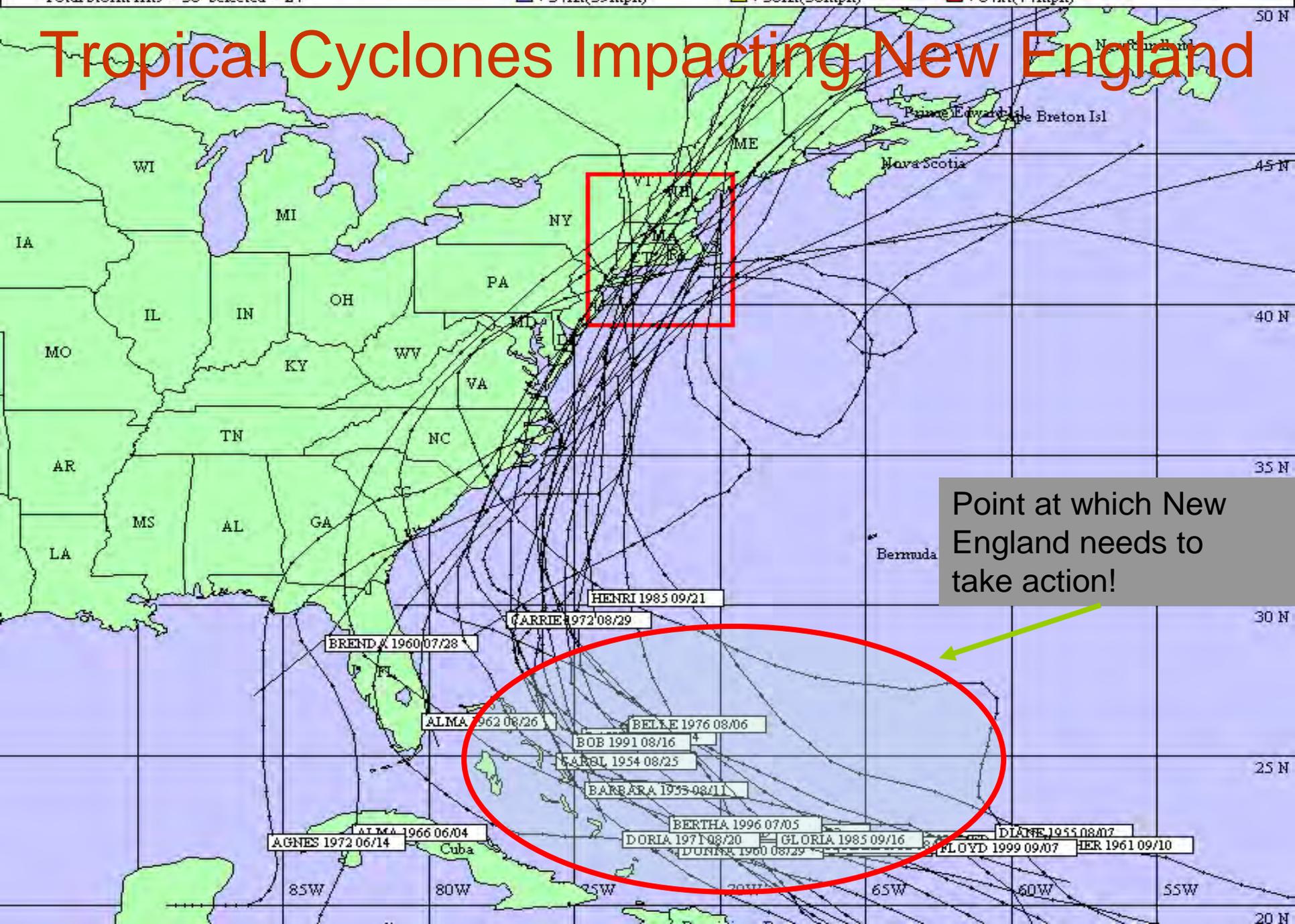
(Hurricane Andrew!)

# 1995 – 19 NAMED STORMS – NONE HIT NEW ENGLAND



2007: Allison -> Andrea; Iris -> Ingrid; Luis -> Lorenzo; Marilyn -> Melissa; Opal -> Olga; Roxanne -> Rebekah;

# Tropical Cyclones Impacting New England



Point at which New England needs to take action!

NWS TAUNTON:

[WWW.WEATHER.GOV/BOSTON](http://WWW.WEATHER.GOV/BOSTON)

NAT'L HURRICANE CENTER:

[WWW.NHC.NOAA.GOV](http://WWW.NHC.NOAA.GOV)



# NATIONAL WEATHER SERVICE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

- HOME
- FORECAST
- PAST WEATHER
- WEATHER SAFETY
- INFORMATION CENTER
- NEWS
- SEARCH
- ABOUT

Local forecast by "City, St" or ZIP code

[Location Help](#)

### News Headlines

- [Heading to the Beach? Check out the forecast...](#)
- [Free Public Hurricane Workshops in Fall River \(7/27\), West Barnstable \(7/28\), and Bourne \(7/29\)](#)

## NWS Weather Forecast Office - Boston / Taunton, MA

Boston, Weather Forecast

[Weather.gov](#) > Boston, MA

**Customize Your Weather.gov**

City, ST

Enter Your City, ST or ZIP Code

Remember Me

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- Current Hazards**
- Current Conditions
- Radar
- Forecasts
- Rivers and Lakes
- Climate and Past Weather
- Local Programs

### Watches/Warnings

Click on the map below to zoom in.

- Drought
- Local Outlook
- River Flooding
- Space
- Briefing Page
- Thunderstorms
- Winter
- Hurricanes**
- Fire Weather



[Watches, Warnings & Advisories](#)



- [Heat Advisory](#) ■
- [Special Weather Statement](#) ■
- [Air Quality Alert](#) ■
- [Hazardous Weather Outlook](#) ■

Last Map Update: Sun, Jul. 19, 2015 at 11:49:09 am EDT



# FACEBOOK: US National Weather Service Boston

facebook

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**US National Weather Service Boston MA** Government Organization

Timeline About Training / Seminars Become an Observer! More

PEOPLE 67,335 likes

ABOUT

- This Facebook page is a NWS service, extending the reach of NWS information. But for the most current information, visit:
- <http://www.weather.gov/boston>

APPS

- Training / Seminars
- Become an Observer!
- Local Radar

---

**US National Weather Service Boston MA** 1 hr · 🌐

[1010 am Sunday]

Severe Weather Update - Please Share!

The highest risk for severe weather is across much of western and north central Massachusetts, mainly between 4 pm and midnight. However, much of southern New England has the potential for severe weather as well. There is uncertainty as to whether or not we see isolated storms, or a more organized complex of storms develop.... See More

**Severe Thunderstorms Possible Late Today and Tonight**  
National Weather Service, Boston, MA

**Timing of Threat Potential: 4 PM TO MIDNIGHT**

**Primary Threat:** Damaging Wind Storms

**Secondary Threats:** Localized Flooding, lightning, and hail

**Risk Level:** High, Moderate, Enhanced, Slight, Marginal

**Tornado:** High, Moderate, Low  
**Max Hail:** Golf Ball, Half Dollar, Quarter  
**Max Wind:** 20+ mph, 30-50 mph, 60-80 mph

Website: [www.weather.gov/boston](http://www.weather.gov/boston) Twitter: @NWSBoston Facebook: <http://www.facebook.com/NWSBoston>



# TWITTER: @NWSBoston

TWEETS 16.2K FOLLOWING 63 FOLLOWERS 31.6K FAVORITES 50

Follow

**NWS Boston** @NWSBoston

Official Twitter Account for National Weather Service - Boston/Taunton, MA. Details: [weather.gov/twitter](http://weather.gov/twitter)

📍 Taunton, MA  
🌐 [weather.gov/boston](http://weather.gov/boston)  
📅 Joined July 2012

Tweets Tweets & replies Photos & videos

**NWS Boston** @NWSBoston · 17m

What does "Enhanced" mean in terms of severe weather? Here's a look at the different categories from @NWSSPC.

| (no label)                                              | (MARG)                                               | (SLGT)                                                              | (ENH)                                                                        | (MOD)                                                      | (HIGH)                                                   |
|---------------------------------------------------------|------------------------------------------------------|---------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------|----------------------------------------------------------|
| No severe thunderstorms expected                        | Isolated severe thunderstorms possible               | Scattered severe storms possible                                    | Numerous severe storms possible                                              | Widespread severe storms likely                            | Widespread severe storms expected                        |
| Lightning/flooding threats exist with all thunderstorms | Localized flooding, lightning, and/or strong winds   | Short-lived and/or not widespread, isolated intense storms possible | More persistent and/or widespread, a few intense                             | Deep and widespread and intense                            | Deep, very widespread and particularly intense           |
| • Storms to 40 mph<br>• Small hail                      | • Wind to 40 mph<br>• 1/4" hail<br>• 10-15 mph winds | • One or two tornadoes<br>• Hail up to 1" (1/2" to 3/4")            | • A few tornadoes<br>• Several reports of wind damage<br>• Hail - 1" to 1.5" | • Widespread reports of wind damage<br>• Hail - 1.5" to 2" | • Widespread reports of wind damage<br>• Hail - 2" to 3" |

⬅️ 2 ➡️ 6 📷 📺

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- Harvey Leonard @HarveyWCVB
- NWS Taunton Skywarn @SWK15CX



Making critical decisions early is key...



*But it has been 61 years since the last  
Category 3 Hurricane!*

***Natural Calamity Strikes At  
About The Time When One  
Forgets Its Terror!***

...Japanese Proverb

***Failing to think through our answers and  
plan accordingly will have devastating  
results!***



**EDGEWOOD YACHT CLUB - PROVIDENCE R. I.**

**PROVIDENCE JOURNAL PHOTO**

**“PREPARE”**

**IS EASIER SAID THAN DONE!**



2005, Pre-Katrina

**Mason-Dixon®**  
**Polling & Research, Inc.**

REGION:

|                |           |
|----------------|-----------|
| Southeast      | 300 (27%) |
| Southwest Gulf | 285 (26%) |
| Mid-Atlantic   | 205 (19%) |
| Northeast      | 310 (28%) |

SOUTHEAST: Florida, Georgia, South Carolina & North Carolina.

SOUTHWEST GULF: Alabama, Mississippi, Louisiana & Texas.

MID-ATLANTIC: Virginia, Maryland, Delaware & New Jersey.

NORTHEAST: New York, Connecticut, Rhode Island, Massachusetts, New Hampshire & Maine.

**HURRICANE TEST – CORRECT ANSWERS OUT OF 20 QUESTIONS**

|                      |                  | AVERAGE CORRECT | TOTAL SCC (100 point sc |
|----------------------|------------------|-----------------|-------------------------|
| OVERALL              |                  | 8               | 42                      |
| CLOSE LIVE TO COAST? | 10 miles or less | 8               | 41                      |
|                      | >10 miles        | 8               | 42                      |
| BEEN IN HURRICANE?   | YES              | 9               | 44                      |
|                      | NO               | 8               | 41                      |

**QUESTION:**

**Geographically, the majority of hurricane fatalities from drowning in the past 33 years have occurred:**

- A - On the open water 7%
- B - Within two miles of the coast 19%

**QUESTION: True or False?**

**Candles are a good source of light in the event of a power failure.**

**True 56%**  
**False 44%**

**QUESTION: True or False? Masking tape will help prevent windows from shattering.**

**True 54%**

Even among those who live within 10 miles of the coast, 16% said they would probably not evacuate, and among those who have experienced a hurricane, an even higher 20% said they would probably not evacuate. Only 33% of coastal residents would evacuate early, as would only 39% of those who have experienced a hurricane before.

# Emergency managers should be Proactive, not Reactive !



# THINK PROACTIVE, NOT REACTIVE

**Photo by John Partipilo, Tennessean.  
Permission granted by Tennessean for use  
in lightning safety presentations only.  
Do NOT post on web.**

A photograph of two men in black and white striped referee shirts and caps standing outdoors at night. A large, bright lightning bolt strikes the sky behind them. The man on the left is looking towards the man on the right, who has his arms crossed. A speech bubble points from the man on the left to the text below.

Do you think the storm  
is close enough to get  
everyone off the field?

# FLEEING HURRICANE GEORGES IN KEY WEST



**TOO LATE!**

AP Photo



# ***Thank you!***

***Glenn Field & Bob Thompson  
NOAA/National Weather Service  
Taunton, MA***

***Web: [weather.gov/boston](http://weather.gov/boston)  
E-mails: [glenn.field@noaa.gov](mailto:glenn.field@noaa.gov)  
[robert.thompson@noaa.gov](mailto:robert.thompson@noaa.gov)***

*Atlantic  
Ocean*

**HURRICANE  
ISABEL**

***Hurricane Isabel – September 2003***